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[Intervention Review]

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old

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ABSTRACT

Background

Acute bronchiolitis is the leading cause of medical emergencies during winter months in infants younger than 24 months old. Chest physiotherapy is sometimes used to assist infants in the clearance of secretions in order to decrease ventilatory effort. This is an update of a Cochrane Review first published in 2005 and updated in 2006, 2012, and 2016.

Objectives

To determine the efficacy of chest physiotherapy in infants younger than 24 months old with acute bronchiolitis. A secondary objective was to determine the efficacy of different techniques of chest physiotherapy (vibration and percussion, passive exhalation, or instrumental).

Search methods

We searched CENTRAL, MEDLINE, Embase, CINAHL, LILACS, Web of Science, PEDro (October 2011 to 20 April 2022), and two trials registers (5 April 2022).

Selection criteria

Randomised controlled trials (RCTs) in which chest physiotherapy was compared to control (conventional medical care with no physiotherapy intervention) or other respiratory physiotherapy techniques in infants younger than 24 months old with bronchiolitis.

Data collection and analysis

We used standard methodological procedures expected by Cochrane.

Main results

Our update of the searches dated 20 April 2022 identified five new RCTs with 430 participants. We included a total of 17 RCTs (1679 participants) comparing chest physiotherapy with no intervention or comparing different types of physiotherapy.

Five trials (246 participants) assessed percussion and vibration techniques plus postural drainage (conventional chest physiotherapy), and 12 trials (1433 participants) assessed different passive flow-oriented expiratory techniques, of which three trials (628 participants) assessed forced expiratory techniques, and nine trials (805 participants) assessed slow expiratory techniques. In the slow expiratory subgroup,

two trials (78 participants) compared the technique with instrumental physiotherapy techniques, and two recent trials (116 participants) combined slow expiratory techniques with rhinopharyngeal retrograde technique (RRT). One trial used RRT alone as the main component of the physiotherapy intervention. Clinical severity was mild in one trial, severe in four trials, moderate in six trials, and mild to moderate in five trials. One study did not report clinical severity. Two trials were performed on non-hospitalised participants.

Overall risk of bias was high in six trials, unclear in five, and low in six trials.

The analyses showed no effects of conventional techniques on change in bronchiolitis severity status, respiratory parameters, hours with oxygen supplementation, or length of hospital stay (5 trials, 246 participants).

Regarding instrumental techniques (2 trials, 80 participants), one trial observed similar results in bronchiolitis severity status when comparing slow expiration to instrumental techniques (mean difference 0.10, 95% confidence interval (C) −0.17 to 0.37).

Forced passive expiratory techniques failed to show an effect on bronchiolitis severity in time to recovery (2 trials, 509 participants; high-certainty evidence) and time to clinical stability (1 trial, 99 participants; high-certainty evidence) in infants with severe bronchiolitis. Important adverse effects were reported with the use of forced expiratory techniques.

Regarding slow expiratory techniques, a mild to moderate improvement was observed in bronchiolitis severity score (standardised mean difference −0.43, 95% CI −0.73 to −0.13; I^2 = 55%; 7 trials, 434 participants; low-certainty evidence). Also, in one trial an improvement in time to recovery was observed with the use of slow expiratory techniques. No benefit was observed in length of hospital stay, except for one trial which showed a one-day reduction. No effects were shown or reported for other clinical outcomes such as duration on oxygen supplementation, use of bronchodilators, or parents' impression of physiotherapy benefit.

Authors' conclusions

We found low-certainty evidence that passive slow expiratory technique may result in a mild to moderate improvement in bronchiolitis severity when compared to control. This evidence comes mostly from infants with moderately acute bronchiolitis treated in hospital. The evidence was limited with regard to infants with severe bronchiolitis and those with moderately severe bronchiolitis treated in ambulatory settings.

We found high-certainty evidence that conventional techniques and forced expiratory techniques result in no difference in bronchiolitis severity or any other outcome. We found high-certainty evidence that forced expiratory techniques in infants with severe bronchiolitis do not improve their health status and can lead to severe adverse effects.

Currently, the evidence regarding new physiotherapy techniques such as RRT or instrumental physiotherapy is scarce, and further trials are needed to determine their effects and potential for use in infants with moderate bronchiolitis, as well as the potential additional effect of RRT when combined with slow passive expiratory techniques. Finally, the effectiveness of combining chest physiotherapy with hypertonic saline should also be investigated.

PLAIN LANGUAGE SUMMARY

Chest physiotherapy for acute bronchiolitis in children younger than two years of age

Key messages

Chest physiotherapy based on slow expiratory techniques may improve disease severity in infants with moderately severe acute bronchiolitis.

What is acute bronchiolitis, and what is the role of chest physiotherapy in this condition?

Acute bronchiolitis is a viral respiratory infection that frequently occurs in infants younger than two years old. Most infants have a mild disease and do not require specific medical treatments or hospitalisation. However, those with moderate or severe disease may present with a build-up of fluid in the airways (mucus secretion), as well as swollen (oedema) or constricted (bronchospasm) airways, that make it difficult to clear phlegm.

Chest physiotherapy may assist in the clearance of respiratory secretions and improve breathing. There are three established types of chest physiotherapy techniques to manage airway clearance: vibration and percussion techniques, forced expiratory techniques, and slow passive expiratory techniques. Additionally, there is emerging evidence on rhinopharyngeal retrograde clearance techniques and instrumental clearance techniques, alone or in combination with other physiotherapy techniques.

What did we want to find out?

The aim of the review was to determine the effectiveness of chest physiotherapy in relieving acute bronchiolitis in infants between 0 and 24 months old, as well as to determine the effectiveness of the different techniques of chest physiotherapy.

What did we do?

We searched for all randomised controlled trials (a type of study where participants are randomly assigned to one of two or more treatment groups) comparing chest physiotherapy interventions against a control or other types of physiotherapy, and looked at their effectiveness by type of technique and bronchiolitis severity.

What did we find?

We included 17 trials with a total of 1679 infants. Five trials (246 infants) tested vibration and percussion techniques (conventional chest physiotherapy); three trials (628 infants) tested forced expiratory techniques; and nine trials (805 infants) tested slow expiratory techniques. Two trials (80 infants) tested instrumental physiotherapy techniques, and three trials (216 infants) tested the rhinopharyngeal retrograde clearance technique (two combined with slow expiratory technique in 116 infants). Disease severity of infants was mild in one trial, severe in four trials, moderate in six trials, and a mix of mild to moderate in five trials. One trial did not report disease severity of infants. Two trials were performed in ambulatory (non-hospitalised) infants, and the rest were performed in hospitalised infants.

We found no effect of conventional physiotherapy on disease severity of infants with moderate bronchiolitis. Forced expiratory techniques also failed to show an effect on bronchiolitis severity in infants with severe disease, while important adverse effects were reported. We have high confidence in this evidence, and new trials are unlikely to challenge these results. Slow expiratory techniques showed a mild to moderate improvement in bronchiolitis severity, mostly in infants with moderate bronchiolitis, based on low-certainty evidence (future studies may challenge this result). Also, one study showed an improvement in time to recovery with slow expiratory techniques in infants with moderate bronchiolitis. No effects were shown or reported for other clinical outcomes such as length of hospital stay, duration of oxygen supplementation, use of bronchodilators, or parents' impression of a benefit from the physiotherapy.

What are the limitations of the evidence?

Despite the positive effects found for some types of chest physiotherapy, most of the trials were poorly designed, which has a direct impact on the certainty and reliability of the results. For some techniques, the evidence for the effect is of low certainty. Furthermore, a larger number of participants, longer interventions, and well-reported adverse events are needed before any firm conclusions can be reached.

The evidence is robust for the older or more established types of physiotherapy (vibration and percussion and forced expiratory techniques) administered to hospitalised infants. The evidence is limited for slow expiratory techniques, and only anecdotal for the newest techniques (rhinopharyngeal retrograde clearance and instrumental clearance techniques), which have been explored in few trials. There is little evidence on the effectiveness of chest physiotherapy in non-hospitalised infants.

How up-to-date is this evidence?

The evidence is current to 20 April 2022.

SUMMARY OF FINDINGS

Summary of findings 1. Slow passive expiration versus control for acute bronchiolitis

Slow passive expiration versus control for acute bronchiolitis

Patient or population: paediatric participants between 0 and 24 months old with acute bronchiolitis

Settings: hospital

Intervention: slow passive expiration

Comparison: control

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	Physiotherapy				
Time to recovery/time to clinical stability Recovery defined as attaining an ABSS clinical score below 2. (follow-up until hospital discharge)	Mean time to recovery 4.4 days (3.7 to 5.1 days)	Mean time to recovery 2.6 days (2.1 to 3.1 days)	NA	71 (1 trial)	⊕⊕⊖⊖ **Low**[a]	Participants with mild to moderate bronchiolitis (Conesa-Segura 2018)
Change in the severity status of bronchiolitis Assessed using a variety of scales (follow-up ranging from 1 hour to hospital discharge)	Mean Wang score of 7.5 (Gomes 2012)[b]	The mean severity score in the intervention group was 0.7 lower (1.2 lower to 0.3 lower).[b]	SMD −0.43 (−0.73 to −0.13)	434 (7 trials)	⊕⊕⊖⊖ **Low**[c]	Participants with mild to moderate bronchiolitis (Conesa-Segura 2018; Gomes 2012; Gomes 2016; Lopez Galbany 2004; Postiaux 2011; Ramos-Pinto 2021; Van Ginderdeuren 2017)
Adverse events (follow-up until hospital discharge)	4 studies reported no adverse events. 1 study reported more episodes of nasal bleeding (28 vs 1) and vomiting (11 vs 7) in the control aspiration group than the clearance physiotherapy group.			565 (6 trials)	⊕⊖⊖⊖ **Very low**[d]	Participants with severe bronchiolitis (Sanchez Bayle 2012) Participants with mild to moderate bronchiolitis

	1 study reported no direct complications (respiratory deterioration with oxygen desaturation, bradycardia, vomiting) due to treatment in any participant. There were 4.3% cases (2 controls and 2 experimental) of complications due to bronchiolitis severity.	(Conesa-Segura 2018; Gomes 2016; Postiaux 2011; Ramos-Pinto 2021; Sanchez Bayle 2012; Van Ginderdeuren 2017)

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

ABSS: Acute Bronchitis Severity Score; **CI:** confidence interval; **NA**: not applicable: **SMD:** standardised mean difference

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded for unclear risk of bias and serious imprecision of estimates due to small sample size.
[b]Assumed risk was taken from the baseline mean severity of the control group in Gomes 2012, which was measured with the Wang severity score and presented low risk of bias in the meta-analysis. SMD was back-transformed into a mean difference multiplying the standard deviation of the Gomes 2012 control group (mean change from baseline to end of study) by the pooled SMD.
[c]Downgraded for unclear risk of bias and imprecision of estimates. Inconsistency of results (I^2 = 55%) did not result in reduced certainty of the evidence because the sensitivity analysis reached similar results with no inconsistency.
[d]Downgraded for unclear risk of bias, serious imprecision of estimates, and serious indirectness of assessments because in 4 of the 6 trials it was unclear what adverse effects were assessed, and 1 of the trials only assessed participants in the intervention group.

Summary of findings 2. Forced expiration versus control for acute bronchiolitis

Forced expiration versus control for acute bronchiolitis

Patient or population: paediatric participants between 0 and 24 months old with acute bronchiolitis

Settings: hospital

Intervention: forced expiration

Comparison: control

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	Physiotherapy				

Time to recovery/time to clinical stability (follow-up until hospital discharge)	Median time to recovery was 2.31 days (1.97 to 2.73) (Gajdos 2010).[a]	Median time to recovery was 2.02 days (1.96 to 2.34) (Gajdos 2010).	3 studies reported no differences between intervention and control in time to recovery/clinical stability.	628 (3 trials)	⊕⊕⊕⊕ **High**	Participants with severe bronchiolitis (Gajdos 2010; Rochat 2010) Participants with mild-moderate bronchiolitis (Remondini 2014)
Change in the severity status of bronchiolitis Assessed using a variety of scales	Mean RDAI severity score of 3.13 (SD 1.81) (Remondini 2014)[b]	Mean RDAI severity score was 3.26 (SD 1.96).[b]	2 studies reported no differences between forced expiration and control or standard physiotherapy (including tapping).	132 (2 trials)	⊕⊖⊖⊖ **Verylow**[c]	Participants with severe bronchiolitis (Rochat 2010) Participants with mild-moderate bronchiolitis (Remondini 2014)
Adverse events (follow-up until hospital discharge)	Adverse events reported in Gajdos 2010: • bradycardia with desaturation (RR 1.0, 95% CI 0.2 to 5.0) • bradycardia without desaturation (RR 3.6, 95% CI 0.7 to 16.9) • transient respiratory destabilisation (RR 5.4, 95% CI 1.6 to 18.4) • vomiting during procedure (RR 10.2, 95% CI 1.3 to 78.8)			599 (2 trials)	⊕⊕⊕⊕ **High**	Participants with severe bronchiolitis (Gajdos 2010; Rochat 2010)

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **NA**: not applicable; **RDAI:** Respiratory Distress Assessment Instrument; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Illustrative comparative risks (assumed and corresponding risks) have been taken from the mean time to recovery assessed in Gajdos 2010, which has a large sample size and low risk of bias in the comparison.
[b]Illustrative comparative risks (assumed and corresponding risks) have been taken from the mean severity score RDAI reported in Remondini 2014.
[c]Downgraded for unclear risk of bias and very serious imprecision of estimates.

BACKGROUND

Description of the condition

Acute bronchiolitis is the leading cause of emergency department visits during winter months in children younger than two years of age. It results in high use of healthcare resources, and is an increasing burden on outpatient practices, emergency departments, and hospitals (Carroll 2008). Between 2% and 3% of children younger than 12 months of age are hospitalised with a diagnosis of bronchiolitis, which accounts for between 57,000 and 172,000 hospitalisations annually in the USA; it also results in significant morbidity in infants (Meissner 2016). Infant mortality rates vary depending on geographical region and the economic status of the family (Scheltema 2017).

In high-income countries, the incidence of bronchiolitis-associated deaths is low, and occurs mainly in infants with severe comorbidities (e.g. congenital heart disease) and prematurity. However, for low-income or lower-middle-income countries, only 28% of deaths were associated with comorbidities, compared with 47% in upper-middle-income and 70% in high-income countries (Holman 2003; Panickar 2005; Scheltema 2017). Furthermore, there is strong evidence of irreversible airway damage and reduced lung function in adults who were hospitalised with bronchiolitis in infancy (Backman 2014; Sigurs 2010). Children who have had respiratory syncytial virus (RSV) disease in early life have been shown to have a higher incidence of asthma/wheezing in later life (odds ratio 3.84, Fauroux 2017; Régnier 2013). Increasing evidence suggests that RSV is a significant risk factor for respiratory morbidity, and is a predisposition to asthma and allergies within the first decade of life and possibly into adulthood. The increased respiratory morbidity may lead to a reduced quality of life and increased healthcare costs (Fauroux 2017).

In 2014, the American Academy of Pediatrics published a statement on the diagnosis and treatment of bronchiolitis (Ralston 2014a). However, the criteria for diagnosing acute bronchiolitis vary greatly. Most doctors agree that the case definition for an episode of acute bronchiolitis should include children aged 24 months or younger who have a first episode of acute wheezing accompanied by physical findings of viral infection (e.g. coryza, cough and fever) (González Caballero 2001; Wainwright 2003).

Most cases of acute bronchiolitis are mild and can be treated on an outpatient basis, while 1% to 3% (depending on the severity of the disease) will require hospitalisation (Ralston 2014b). Risk factors associated with the need for hospitalisation are young age, premature birth, chronic lung disease, congenital heart disease, and a compromised immune system (Ralston 2014a). In low-income countries, the most frequent risk factors associated with hospitalisation and severe disease include living in a low-income family, malnutrition, low birthweight, age of the mother, mother's education level, being bottle-fed, and premature birth (Scheltema 2017; Smyth 2006; Spencer 1996).

Description of the intervention

The aim when treating acute bronchiolitis is to ensure adequate oxygenation, fluid intake, nasal airway clearance, and feeding of the infant (NICE 2021; PREDICT 2019; Ralston 2014a). Pharmacological strategies include bronchodilators, antibiotics, and steroids, but their effectiveness remains uncertain, and current guidelines do not recommend their use (Cavaye 2018; Ralston 2014a). There is no evidence to support the use of glucocorticoids or antibiotics (Farley 2014; Fernandes 2013), and although there is some poor-quality evidence that bronchodilators, nebulised hypertonic saline, epinephrine, and heliox therapy may have some benefit in terms of improving clinical scores (Gadomski 2014; Hartling 2011; Liet 2015; Umoren 2011; Zhang 2017), this benefit must be weighed against the lack of benefit in reducing the duration or severity of illness, costs, and adverse effects. Furthermore, non-invasive nasal airways clearance is also recommended for bronchiolitis in order to decrease nasal obstruction (Norris 2018), and could have an impact on length of hospital stay (Mussman 2013). However, there is still controversy over the effects of nasal aspiration versus nasopharyngeal suctioning (Ringer 2020).

Chest physiotherapy has been proposed to assist in the clearance of tracheobronchial, and, recently, nasal secretions. The main goal is to decrease airway obstruction produced by secretions; reduce airway resistance; enhance gas exchange; and reduce the work of breathing. Different techniques are used in paediatric patients: 1) conventional chest physical therapy (cCPT) such as chest percussion and vibration in combination with postural drainage positions, chest shaking, and directed coughing; 2) flow-based techniques: slow or forced passive expiration, which may help to mobilise secretions from bronchioles or bronchi, respectively, towards the trachea and trigger coughing which helps to remove secretions; 3) instrumental techniques based on thorax vibration, intrapulmonary percussive ventilation, and high-frequency chest wall compression, which produce an airway's oscillation that improves mucus transportation by modifying its rheology and improving cilia beating; and recently 4) rhinopharyngeal retrograde technique (RRT), which uses forced nasal inspiration to remove secretions from the nasal cavity towards the mouth. However, there may be drawbacks to conventional chest physiotherapy and forced passive expiration techniques. It has been claimed that they might cause distress to the infant, and concerns have arisen about the safety of the procedures, especially in relation to rib fractures in at-risk patients (Beeby 1998; Chalumeau 2002; Chanelière 2006). Ensuring safety and reducing adverse effects should also be a priority when assessing the efficacy of new chest physiotherapy techniques.

How the intervention might work

Chest physiotherapy should decrease airway obstruction and reduce flow resistance and the work of breathing by enhancing the mucociliary transportability. Initially, airway clearance techniques were based on the effects of the airflow over the mucus in which the airflow friction improved mucus transportation. However, current evidence explores the effects produced at the biomechanical and biochemical levels. The mechanical stress produced by airflow, airways stretching and pressure during chest physiotherapy generates changes in mucus rheology (Button 2008; Button 2013); increases ciliary beat frequency (Button 2018); and increases the water volume in secretions, all of which means the mucus becomes more fluid and transportable (Button 2013). Considering this evidence-based approach, chest physiotherapy might be used only when there is an indication of airway obstruction due to mucus secretions, ideally in children with moderate or mild acute bronchiolitis, because their severity level indicates the need for manual and mechanical clearance techniques in order to avoid adverse effects. Finally, the physiological effects are not immediate,

and can take up to three hours before maximum benefit is realised. This delay must be considered when assessing postintervention effects of chest physiotherapy for acute bronchiolitis.

Why it is important to do this review

When this review was first published, there was uncertainty about the efficacy of conventional physiotherapy techniques (vibration, percussion and postural drainage). The review challenged their use in daily practice, prompting the recommendation that chest physiotherapy based on vibration and percussion should not be routinely used in hospitals (BGT 2005; Ralston 2014a; SIGN 2006). However, chest physiotherapy is still being used in outpatient and inpatient settings (Barben 2008; González 2010a). Parents' expectations and demands for chest physiotherapy in clinical daily practice may explain its widespread use (Sanchez 2007).

New and gentler passive expiratory physiotherapy techniques have become mainstream in many countries. In Chile, the Health Ministry introduced the slow expiratory technique into clinical guidelines for bronchiolitis management in outpatient and inpatient settings (Ministerio de Salud Chile 2013). This Chilean guideline points to the fact that the physiotherapy intervention is linked to the severity score, mild or moderate, and must always be followed up with a strict assessment after the intervention, to determine clinical efficacy. In France, forced expiratory techniques are not recommended by the health authority for the first bronchiolitis episode due to their adverse effects, except for those children who have chronic respiratory comorbidities or poor cough reflex (Haute Autorité de Santé: HAS-FR 2019). However, forced expiratory techniques are widely used in outpatient settings in France (David 2010; Halna 2005; Touzet 2007). In other countries such as the UK (NICE 2021), the USA (Ralston 2014a), and Spain (Ministerio Sanidad 2011), chest physiotherapy is only recommended for people with comorbidities or for those with atelectasis due to airway obstruction.

The use of chest physiotherapy varies around the world. Differences could be attributed to the intervention approach and the techniques used to assess and treat the physiopathological condition of the airway obstruction of the infant. Results differ depending on the technique used.

Given what seems to be contrary evidence on routine use of chest physiotherapy in infants with acute bronchiolitis, we were motivated to shift the focus of this review to assess the efficacy and safety of passive expiratory techniques, and to explore the differential effects of chest physiotherapy, depending on the technique used, severity of the disease, and the setting of the physiotherapy.

OBJECTIVES

To determine the efficacy of chest physiotherapy in infants younger than 24 months old with acute bronchiolitis. A secondary objective was to determine the efficacy of different techniques of chest physiotherapy (vibration and percussion, passive exhalation, or instrumental).

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) evaluating chest physiotherapy in paediatric patients with acute bronchiolitis.

Types of participants

Infants younger than 24 months of age with acute bronchiolitis, as defined by the trial authors, in all settings.

Types of interventions

We included trials that compared any type of chest physiotherapy (postural drainage, chest percussion, vibration, chest shaking, directed coughing, slow or forced expiration techniques, rhinopharyngeal retrograde clearance technique, and instrumental techniques) versus control (conventional medical care with no physiotherapy intervention) or other respiratory physiotherapy techniques.

We classified the interventions into four main categories: positioning + vibration and percussion, passive flow expiratory techniques, rhinopharyngeal retrograde clearance technique, and instrumental techniques. We further subdivided passive expiratory techniques into slow passive expiratory techniques and forced passive expiratory techniques.

We considered the following four comparisons.

1. Slow passive expiratory techniques versus control.
2. Slow passive expiratory techniques versus instrumental techniques.
3. Forced passive expiratory techniques versus control.
4. Positioning plus percussion and vibration (conventional techniques) versus control.

Types of outcome measures

Primary outcomes

1. Time to recovery.
2. Change in the severity status of bronchiolitis.

Secondary outcomes

1. Respiratory parameters (oxygen saturation levels, transcutaneous carbon dioxide partial pressure ($PaCO_2$)).
2. Duration of oxygen supplementation.
3. Length of hospital stay in hospitalised infants.
4. Avoidance of hospitalisations or emergency visits in ambulatory patients.
5. Use of bronchodilators and steroids.
6. Parents' impression of physiotherapy benefit.
7. Adverse events, defined as any undesired outcome due to the intervention, e.g. rib fractures, bradycardia, respiratory instability, vomiting, or long-term neurological disabilities. We took all outcomes into consideration. We described the methods used to measure any adverse events.

Search methods for identification of studies

Electronic searches

In this update we searched the Cochrane Central Register of Controlled Trials (CENTRAL 2022, Issue 4) (accessed 20 April 2022), the Cochrane Acute Respiratory Infections Group's Specialised Register (October 2011 to 20 April 2022), MEDLINE and MEDLINE In-Process and Other Non-Indexed Citations (October 2011 to 20 April 2022), Embase (October 2011 to 20 April 2022), CINAHL (Cumulative Index to Nursing and Allied Health Literature) (October 2011 to 20 April 2022), LILACS (Latin American and Caribbean Health Science Information database) (October 2011 to 20 April 2022), Web of Science (October 2011 to 20 April 2022), and PEDro (October 2011 to April 2022).

We used the search strategy described in Appendix 1 to search CENTRAL and MEDLINE. We did not combine the search strategy with a filter for identifying randomised trials, as there were too few results. We adapted the search strategy to search MEDLINE In-Process (Appendix 2), Embase (Appendix 3), CINAHL (Appendix 4), LILACS (Appendix 5), and Web of Science (Appendix 6). See Appendix 7 for details of previous searches.

Searching other resources

We searched the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (trialsearch.who.int/) and ClinicalTrials.gov (www.clinicaltrials.gov/) trials registers with the search terms bronchiolitis AND "chest physiotherapy" for completed and ongoing trials (5 April 2022).

In the first publication of this review, we examined the reference lists of general paediatric, infectious diseases, pneumatology, and physiotherapy textbooks. We reviewed the reference lists of all selected articles and recent review articles and also examined published abstracts from the Pediatric Academic Societies' Annual Meetings (US) (1999 to 2003). We handsearched the French journals *Journal Pédiatrie Puériculture* (1999 to May 2004) and *Archives de Pédiatrie* (1994 to 1997; 2000 to May 2004).

Data collection and analysis

Selection of studies

Three review authors (CG, MG, MR) independently screened the results from the initial search of all the databases and reference lists to identify potentially relevant citations. We obtained the full-text articles of those abstracts or titles deemed potentially relevant. Four review authors (CG, MG, MR, JV) independently decided on which trials to include using a standardised form. There were no disagreements regarding which trials to include in the review. We recorded the selection process in sufficient detail to complete a PRISMA flow diagram (Figure 1) (Moher 2009).

Figure 1. Study flow diagram.

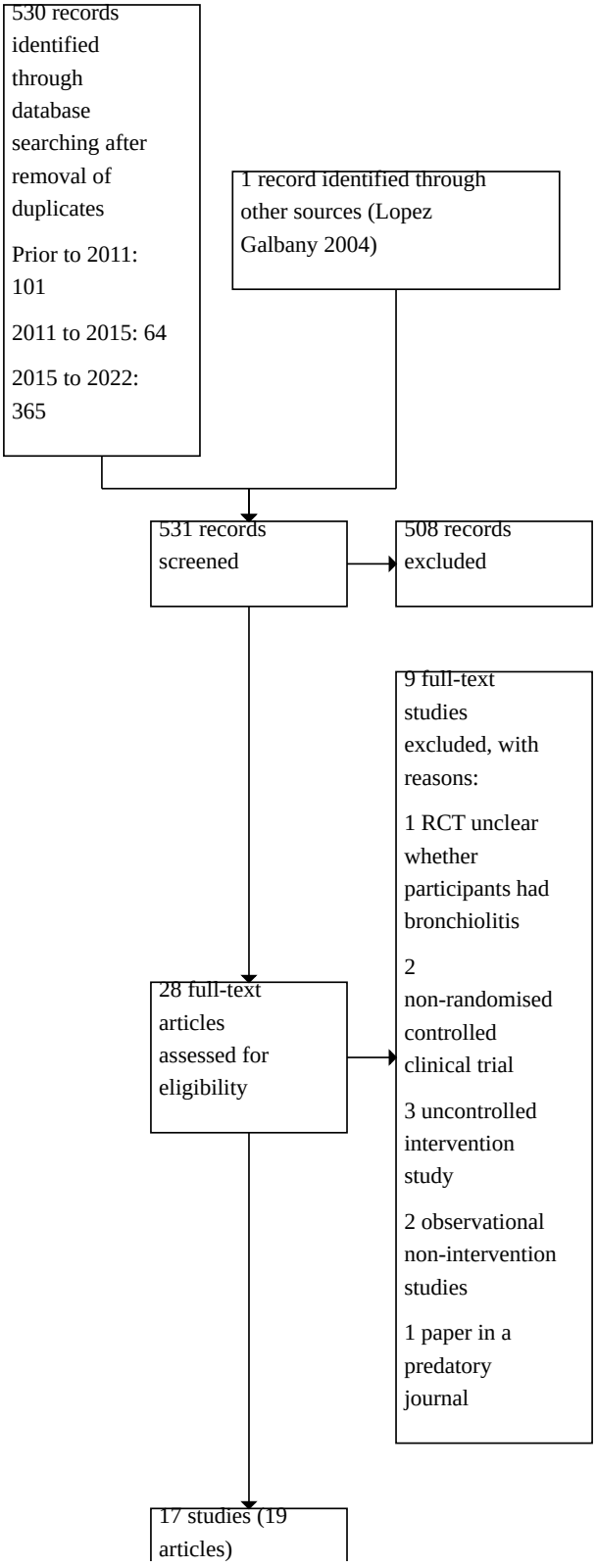
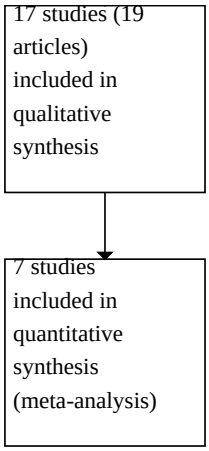


Figure 1. (Continued)



Data extraction and management

Two review authors (MR, MG) independently extracted data from the included studies. We used a standardised form to extract the following data.

1. Characteristics of the study (design, method of randomisation, withdrawals, dropouts).
2. Participants (age, gender, low birthweight or normal weight, ambulatory or hospital patients, disease severity, nutritional status).
3. Intervention (type of chest physiotherapy, administration, co-interventions) and its comparator.
4. Outcomes (types of outcome measures, timing of outcomes, adverse effects).
5. Results.

Assessment of risk of bias in included studies

Two review authors (MG, MR) independently assessed the risk of bias for each included study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). Any disagreements were resolved by discussion.

1. Sequence generation (selection bias)

We described for each included study the methods used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups. We assessed the methods as:

1. low risk of bias (any truly random process, e.g. random number table; computer random number generator);
2. high risk of bias (any non-random process, e.g. odd or even date of birth; hospital or clinic record number); or
3. unclear risk of bias.

2. Allocation concealment (selection bias)

We described for each included study the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocation could have been foreseen in advance of, or during recruitment, or changed after assignment. We assessed the methods as:

1. low risk of bias (e.g. telephone or central randomisation; consecutively numbered, sealed, opaque envelopes);
2. high risk of bias (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth); or
3. unclear risk of bias.

3. Blinding (performance and detection bias)

We assessed the combined risk of performance and detection bias based on the blinding procedures implemented in the studies to prevent families, healthcare personnel treating the participants, and outcome assessors from knowledge of the treatment participants received. For each included study we described all the methods used, if any, to blind families, study and healthcare personnel, and outcome assessors from knowledge of which intervention a participant received. We also provided information on whether the intended blinding was effective. Where blinding was not possible, we assessed whether the lack of blinding was likely to have introduced bias. We assessed the methods as:

1. low risk of bias;
2. high risk of bias; or
3. unclear risk of bias.

4. Incomplete outcome data (attrition bias through withdrawals, dropouts, and protocol deviations)

We described for each included study and for each outcome or class of outcomes the completeness of data including attrition and exclusions from the analysis. We stated whether attrition and exclusions were reported, the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported, and whether missing data were balanced across groups or were related to outcomes. We assessed whether each study was at:

1. low risk of bias;
2. high risk of bias; or
3. unclear risk of bias.

5. Selective reporting bias

We described for each included study how we examined the possibility of selective outcome reporting bias and what we found. We assessed the methods as:

1. low risk of bias (where it was clear that all of the study's prespecified outcomes and all expected outcomes of interest to the review were reported);
2. high risk of bias (where not all of the study's prespecified outcomes were reported; one or more reported primary outcomes were not prespecified; outcomes of interest were reported incompletely and so could not be used; the study failed to include results of a key outcome that would have been expected to have been reported); or
3. unclear risk of bias.

6. Other sources of bias

We described for each included study any important concerns we had about other possible sources of bias, in particular regarding contamination. We assessed each study as at:

1. low risk of bias;
2. high risk of bias; or
3. unclear risk of bias.

Measures of treatment effect

We estimated the effect of treatment by mean differences (MDs) and standardised mean differences (SMD) for continuous outcomes, and risk ratios (RRs) for dichotomous outcomes, with their corresponding confidence intervals (CIs). We estimated the effect of treatment with SMD when continuous outcomes were measured with different scales across trials. We considered that SMD < 0.2 corresponded to a small effect size; around 0.5 to a medium effect size; and more than 0.8 to a large effect size.

Unit of analysis issues

Had cluster-randomised trials been included in the review, we would have assessed their data analysis in search of possible unit of analysis errors, and combined them with individually randomised trials if no errors were observed. We did not expect to identify any cross-over randomised trials on this topic given the short course of bronchiolitis.

A trial with three arms was meta-analysed in the 'slow passive expiratory technique versus control' comparison by pooling the data from the two active arms (Van Ginderdeuren 2017), and comparing these pooled data against the control arm to avoid incurring unit of analysis errors (Higgins 2011). In the 'slow passive expiratory technique versus instrumental techniques' comparison, the two active arms of the trial were compared against each other.

Dealing with missing data

We assessed the impact of missing data on the results of the risk of bias assessment, considering the magnitude of missing data for each trial and how the missing data were dealt with. We tried to assess how many participants were excluded from the analysis, to which treatment group they belonged, the reasons for excluding them, and whether their exclusion biased the results. We planned that if a quantitative analysis was performed, the main analysis would be based on the available data, and a secondary intention-to-treat (ITT) sensitivity analysis would be performed for dichotomous outcomes. The ITT subanalysis would use imputation, assuming that all missing data corresponded to a negative outcome.

Assessment of heterogeneity

We planned to assess statistical heterogeneity using the I^2 statistic, considering values $I^2 \geq 50\%$ as indicative of moderate to high heterogeneity if the included trials were similar enough to perform a quantitative analysis (Higgins 2003).

Assessment of reporting biases

We did not explore publication bias and other reporting biases statistically or graphically due to the lack of statistical data in the included trials.

Data synthesis

We did not perform a meta-analysis for the comparisons of positioning plus percussion and vibration (conventional techniques) and forced passive expiratory technique, due to clinical heterogeneity and statistical considerations. We were able to meta-analyse the results for severity of bronchiolitis clinical score outcome for the slow passive expiratory techniques comparison. We conducted a narrative synthesis describing the individual results with the effect measures reported in the original trials. We conducted a meta-analysis through a statistical pooling of effect measures with a random-effects model, applying the inverse-variance method. We wrote the review using Review Manager 5 (Review Manager 2020).

Subgroup analysis and investigation of heterogeneity

We proposed two subgroup analyses for the main outcomes based on the hypothesis that performance of slow flow chest physiotherapy techniques could depend on disease severity and, consequently, on setting (inpatient versus outpatient). We introduced a subgroup analysis by disease severity, classifying trials into severe, mild to moderate, and unknown categories depending on the inclusion criteria of the trial or the characteristics of the included participants. We proposed a second subgroup analysis by setting, classifying trials into inpatient/outpatient categories, under the hypothesis that infants with more severe bronchiolitis would be seen in inpatient settings, while infants with mostly moderate or mild bronchiolitis severity would be treated in outpatient settings.

In this update, we added a new, post hoc subgroup analysis to the slow passive expiratory techniques comparison, to show results separately for those trials using physiotherapy techniques with and without RRT. We classified the trials into three categories, depending on whether the physiotherapy techniques incorporated RRT or not. This subgroup analysis was a purely descriptive exploration, and we did not consider the meta-analysed results separately by subgroup as the evidence was too scarce for the results to be reliable.

Sensitivity analysis

We planned that if a quantitative analysis of dichotomous outcomes was performed, we would carry out an ITT sensitivity analysis for dichotomous outcomes, imputing all missing data as a negative outcome.

Summary of findings and assessment of the certainty of the evidence

We included two summary of findings tables for the comparisons of 'slow passive expiration techniques versus control' and 'forced expiration techniques versus control', including the following outcomes: time to recovery/clinical stability, changes in severity status, and adverse effects. Illustrative comparative risks are presented in the tables, taking the values observed in the control groups as the assumed risks. We assessed the certainty of evidence using the GRADE approach (Guyatt 2008), which is based on the extent to which users can be confident that an association reflects the item being evaluated (Guyatt 2008). Assessment of the certainty of evidence is based on the five GRADE considerations (risk of bias, heterogeneity, directness of the evidence, risk of publication bias, and precision of effect estimates) (Guyatt 2011a; Guyatt 2011b; Guyatt 2011c; Guyatt 2011d; Guyatt 2011e; Guyatt 2011f; Guyatt 2011g; Guyatt 2011h). For outcomes where no meta-analysis was possible, we followed guidelines for rating the certainty of evidence in a narrative synthesis (Murad 2017). We developed summary of findings tables using GRADEpro GDT software (GRADEpro GDT).

RESULTS

Description of studies

Results of the search

We updated the searches on 20 April 2022. We retrieved 365 records, and included five new trials (Conesa-Segura 2018; Gomes 2016; González-Bellido 2020; Ramos-Pinto 2021; Van Ginderdeuren 2017). We excluded three new trials (Evenou 2017; Sebban 2017; Sebban 2019), and identified five new ongoing trials (NCT02708147; NCT02853838; NCT03738501; NCT03753802; NCT04553822).

Included studies

See Characteristics of included studies table.

We included 17 RCTs (1679 participants) in the review (Aviram 1992; Bohe 2004; Conesa-Segura 2018; De Córdoba 2008; Gajdos 2010; Gomes 2012; Gomes 2016; González-Bellido 2020; Lopez Galbany 2004; Nicholas 1999; Postiaux 2011; Ramos-Pinto 2021; Remondini 2014; Rochat 2010; Sanchez Bayle 2012; Van Ginderdeuren 2017; Webb 1985).

A description of included trials by type of intervention is shown in Table 1. Regarding the intervention type, we classified the intervention groups as follows: 1) use of classic techniques such as percussion and vibration (without any modifications in the current update); 2) forced expiration techniques; 3) slow flow techniques including the retrograde rhinopharyngeal clearance technique; and 4) instrumental techniques (González-Bellido 2020; group 2 of Van Ginderdeuren 2017).

Five trials (246 participants) assessed percussion and vibration techniques (Aviram 1992; Bohe 2004; De Córdoba 2008; Nicholas 1999; Webb 1985), and 12 trials (1433 participants) assessed different passive flow-oriented expiratory techniques, of which three trials (628 participants) assessed forced expiratory techniques (Gajdos 2010; Remondini 2014; Rochat 2010), and nine trials (805 participants) assessed slow expiratory techniques (Conesa-Segura 2018; Gomes 2012; Gomes 2016; González-Bellido 2020; Lopez Galbany 2004; Postiaux 2011; Ramos-Pinto 2021; Sanchez Bayle 2012; Van Ginderdeuren 2017). The most recent trials (216 participants) used a rhinopharyngeal retrograde technique (RRT) as a component of their physiotherapy intervention, which consists of a forced nasal inspiratory manoeuvre based on the inspiratory reflex that follows a slow and prolonged expiration (Conesa-Segura 2018; Gomes 2016; Ramos-Pinto 2021). The majority of trials compared chest physiotherapy against a control, which was described generally as 'no intervention' (Aviram 1992; Bohe 2004; Conesa-Segura 2018; Lopez Galbany 2004; Nicholas 1999; Ramos-Pinto 2021; Rochat 2010; Webb 1985), or a conventional approach that was defined differently across trials, and included postural drainage and tracheal aspiration, and was in some cases combined with tapping and percussion (De Córdoba 2008; Gajdos 2010; Gomes 2012; Gomes 2016; Postiaux 2011; Remondini 2014; Sanchez Bayle 2012).

Two of the included trials assessed the effect of slow passive expiratory techniques against an active instrumental comparator: intrapulmonary percussive ventilation (IPV), Van Ginderdeuren 2017, or high frequency chest wall compression (HFCWC), González-Bellido 2020.

Fifteen of the included trials evaluated the efficacy of chest physiotherapy in hospitalised infants with a clinical diagnosis of acute bronchiolitis. We classified the trials by the clinical severity of the disease, as reported in the papers or as estimated by the review authors. Clinical severity of participants was mild in one trial (De Córdoba 2008 1.9 mean Silverman-Anderson score at baseline, out of 10 maximum score); mild to moderate in nine trials (Bohe 2004 5.7 mean Wang score at baseline; Gomes 2012 75% of participants with a four to eight points in the Wang score; Postiaux 2011 5.75 mean Wang score at baseline; Webb 1985 11 mean clinical score at admission over 30 maximum score; Lopez Galbany 2004 5.6 mean Wang score at baseline; Remondini 2014 5.8 mean respiratory distress assessment instrument (RDAI) score at baseline; Conesa-Segura 2018 92% had Acute Bronchiolitis Severe Scale (ABSS) <= 9; Gomes 2016 72% had Wood score <= 7; Van Ginderdeuren 2017 restricted inclusion to Wang score >= 3 and <= 8); and severe in four trials (Gajdos 2010; Nicholas 1999; Rochat 2010; Sanchez Bayle 2012). The trials of infants with severe bronchiolitis also included infants who required nasogastric feeding or intravenous fluid. The severity of bronchiolitis in one trial was unknown (Aviram 1992).

Two trials were performed on ambulatory, non-hospitalised infants (González-Bellido 2020; Ramos-Pinto 2021). In both cases disease severity was mild to moderate, by either the Wang or the Kristjansson score. In González-Bellido 2020, infants received only one physiotherapy session. In Ramos-Pinto 2021, infants received five sessions during the first week and three sessions during the second week. No adverse events were observed in either trial.

The trials were carried out in the UK (Nicholas 1999; Webb 1985), Spain (Conesa-Segura 2018; González-Bellido 2020; Lopez Galbany 2004; Sanchez Bayle 2012), Brazil (De Córdoba 2008; Gomes 2012; Gomes 2016; Remondini 2014), France (Gajdos 2010), Belgium (Postiaux 2011; Van Ginderdeuren 2017), Israel (Aviram 1992), Argentina (Bohe 2004), Portugal (Ramos-Pinto 2021), and Switzerland (Rochat 2010). Two of the included trials were unpublished, and we contacted the trial authors for further clarification and data gathering (Aviram 1992; Lopez Galbany 2004). We contacted the authors of several trials asking for clarification and additional information, with positive responses (Aviram 1992; Gomes 2012; Lopez Galbany 2004; Postiaux 2011; Rochat 2010; Sanchez Bayle 2012).

Only three trials specifically reported funding from governmental organisations (Gajdos 2010; González-Bellido 2020; Rochat 2010). Four trials declared no conflicts of interest (Postiaux 2011; Ramos-Pinto 2021; Sanchez Bayle 2012; Van Ginderdeuren 2017), and the other trials did not report on conflicts of interest.

Excluded studies

See Characteristics of excluded studies table.

We excluded nine trials after full-text screening. One trial was a single-blind randomised clinical trial including infants under two years of age with moderate acute wheezing episodes attending an outpatient clinic (Castro 2014). We excluded two trials due to being non-randomised comparative trials (Belcastro 1984; Pupin 2009), three trials that were uncontrolled intervention trials (Bernard-Narbonne 2003; Postiaux 2004; Quitell 1988), and two trials that were observational non-intervention trials (Evenou 2017; Sebban 2017). We excluded one trial because it was published in a predatory journal (Sebban 2019).

One excluded trial randomised 48 participants to receive salbutamol with or without chest physiotherapy using slow and long expiratory flow and assisted cough techniques (Castro 2014). After inclusion of the participant by a family physician, those infants in the chest physiotherapy group received physiotherapy for one hour. Afterwards the infant was assessed by the family physician, who was blinded to intervention status, for re-evaluation of his or her clinical status, clinical score, and oxygen saturation (SpO_2) level. If the infant met the criteria of improvement, they were discharged. Otherwise, the participant received a second hour of treatment, according to their original randomised group. After the second hour, the infant was assessed again by the original family physician and referred to the hospital for admission if the criteria of improvement based on the clinical score was still not achieved. The study endpoints were clinical score, SpO_2, number of hospital admissions, and parents' satisfaction.

Details for the two non-randomised comparative trials were as follows.

Belcastro 1984 was a pilot study with 12 patients that compared:

1. osteopathic manipulative treatment to postural drainage in a non-randomised fashion (first three participants received osteopathy, and the rest received postural drainage); and
2. bronchodilators to placebo in a randomised, double-blind fashion.

The endpoints were number of hospital days and mean daily respiratory rates.

Pupin 2009 was a comparative controlled intervention trial that included 81 infants with clinically and radiologically diagnosed acute viral bronchiolitis. Infants were non-randomly allocated to receive forced expiratory flow technique (FET), vibration plus postural drainage, or a control procedure (no respiratory therapy, only manual contact of the physical therapist on the thorax). Each procedure consisted of a single therapeutic session performed in the morning for 10 minutes. Heart rate, respiratory rate, and SpO_2 were assessed before the procedure and at 10, 30, and 60 minutes afterwards. The authors concluded that "In terms of overall improvement of cardiorespiratory parameters, neither the FET nor vibration/PD provided any benefit to infants with acute viral bronchiolitis. However, over time, respiratory physical therapy seems to contribute to decreasing the respiratory rate in these patients".

Risk of bias in included studies

The overall risk of bias for the comparison vibration and percussion techniques was unclear or high, because of the lack of description and limitations associated with the assessment of risk of bias in the five trials (Aviram 1992; Bohe 2004; De Córdoba 2008; Nicholas 1999; Webb 1985) (Figure 2; Figure 3).

Figure 2. Risk of bias graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.

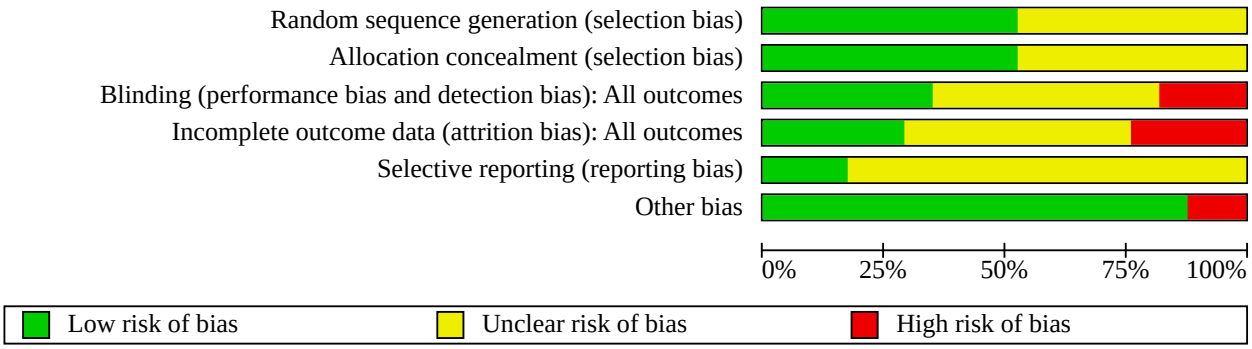
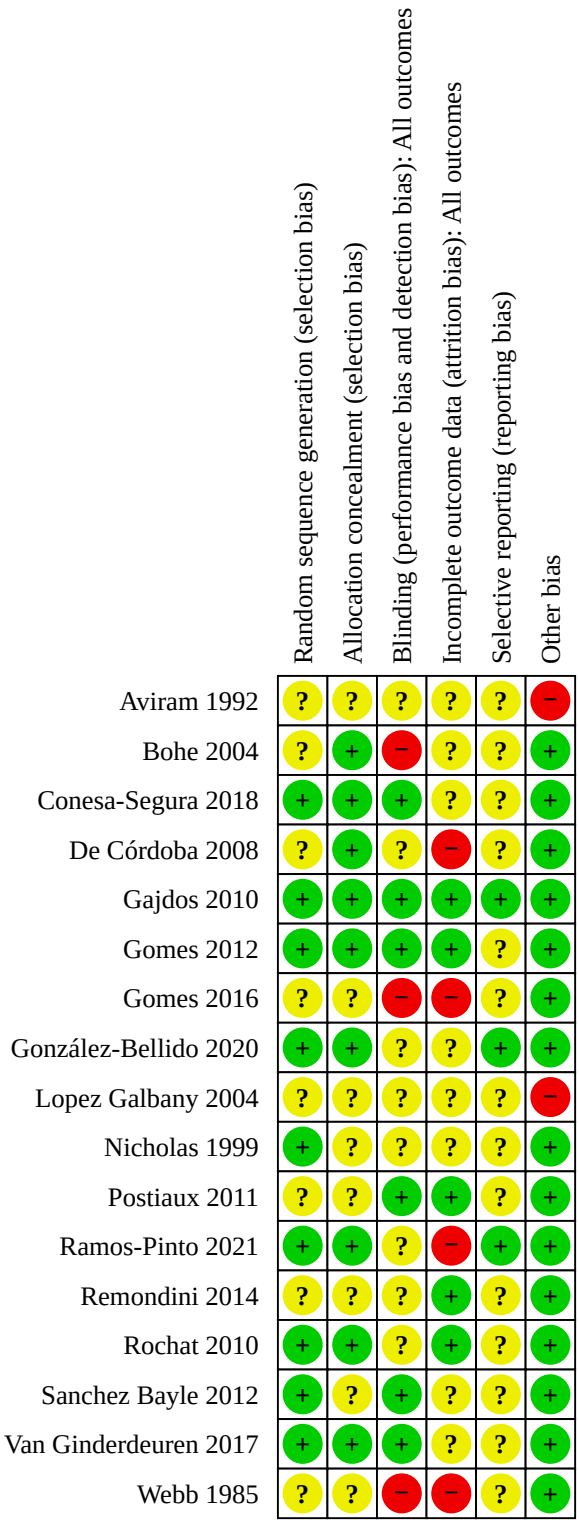


Figure 3. Risk of bias summary: review authors' judgements about each methodological quality item for each included study.



The overall risk of bias for the comparison forced expiratory techniques was unclear. Two trials comparing forced expiration techniques were at low risk of bias (Gajdos 2010; Rochat 2010), and one trial was at unclear risk of bias (Remondini 2014).

The comparison of slow flow techniques (including the retrograde rhinopharyngeal clearance technique) has four trials at low risk of bias (Conesa-Segura 2018; Gomes 2012; González-Bellido 2020; Van Ginderdeuren 2017), four trials at unclear risk of bias (Lopez Galbany 2004; Postiaux 2011; Ramos-Pinto 2021; Sanchez Bayle 2012), and one trial at high risk of bias (Gomes 2016).

Allocation

Scant information was provided regarding randomisation methods and allocation concealment. Ten trials described adequate sequence generation procedures (Conesa-Segura 2018; Gajdos 2010; Gomes 2012; Gomes 2016; González-Bellido 2020; Nicholas 1999; Ramos-Pinto 2021; Rochat 2010; Sanchez Bayle 2012; Van Ginderdeuren 2017). Seven trials either described procedures to conceal allocation (De Córdoba 2008; Gajdos 2010; Gomes 2012; Rochat 2010; Van Ginderdeuren 2017), or claimed to have concealed allocation (Bohe 2004; Conesa-Segura 2018).

Blinding

Six trials reported masking of families or healthcare personnel, or both, describing having implemented measures to prevent them from knowledge of the treatment allocation (Conesa-Segura 2018; Gajdos 2010; Gomes 2012; Postiaux 2011; Sanchez Bayle 2012; Van Ginderdeuren 2017).

Masking of outcome assessment was most likely absent in all but two of the included trials. Eight trials implemented rigorous procedures to mask outcome assessments (Conesa-Segura 2018; Gajdos 2010; Gomes 2012; González-Bellido 2020; Postiaux 2011; Rochat 2010; Sanchez Bayle 2012; Van Ginderdeuren 2017), but the other trials were admittedly open (Bohe 2004; Rochat 2010; Webb 1985), or most likely so (Aviram 1992; De Córdoba 2008; Gomes 2016; Lopez Galbany 2004; Nicholas 1999; Ramos-Pinto 2021). Even though some outcomes were objective and not subject to bias (oxygen saturation, heart rate), other outcomes depended on observation and could be more vulnerable (clinical scores and respiratory discomfort questionnaire).

Incomplete outcome data

A single trial had a large sample size and an adequate description of attrition of participants, as well as a description of how they were handled (ITT analysis) (Gajdos 2010). Another trial had a large sample and an adequate description of attrition of participants (Rochat 2010). In the rest of the included trials the attrition of participants was either null (Gomes 2012; Postiaux 2011; Ramos-Pinto 2021), or low and unclearly dealt with (Bohe 2004; Conesa-Segura 2018; De Córdoba 2008; Gomes 2016; González-Bellido 2020; Nicholas 1999; Sanchez Bayle 2012; Webb 1985; Van Ginderdeuren 2017).

Selective reporting

Three trials had a low risk of selective reporting bias, as shown by comparing the trial protocol with the published paper (Gajdos 2010; González-Bellido 2020; Ramos-Pinto 2021). Assessment of selective reporting bias was not possible for the remaining trials due to the scarcity of available data.

Other potential sources of bias

Two trials were at high risk of other potential biases because they were only published as abstracts (Aviram 1992; Lopez Galbany 2004). We identified no other potential sources of bias for the remaining trials.

Effects of interventions

See: **Summary of findings 1** Slow passive expiration versus control for acute bronchiolitis; **Summary of findings 2** Forced expiration versus control for acute bronchiolitis

The inclusion of trials with valid data and similar assessments permitted the pooling of data for change in the severity status of bronchiolitis for slow passive expiratory technique. We have summarised all other outcomes for all comparisons narratively.

Comparison 1: slow passive expiratory techniques versus control

Primary outcomes

A summary or results is presented in Summary of findings 1.

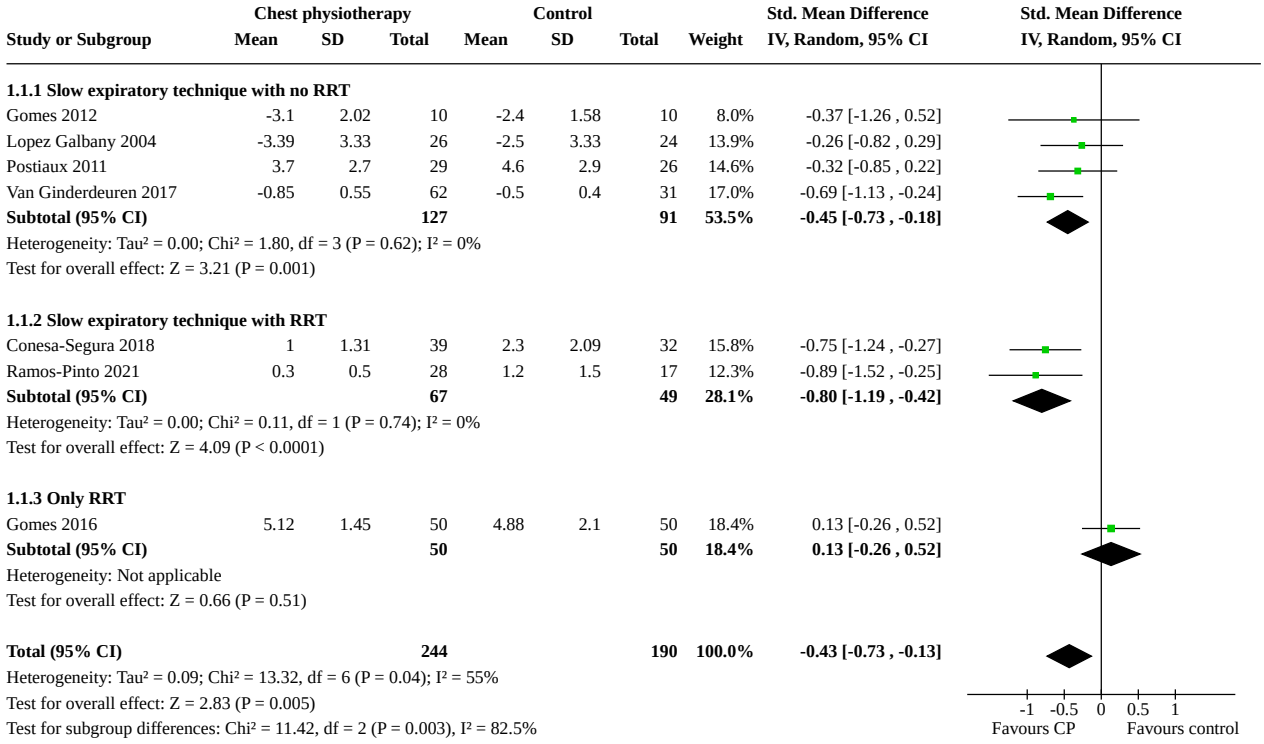
1. Time to recovery

One study (71 infants) reported data on time to recovery. Conesa-Segura 2018 assessed time to recovery as the mean time to reach an ABSS (Acute Bronchiolitis Severe Scale) clinical score value below two points. The authors report that mean recovery time was statistically significantly shorter in the experimental group (2.6 days, 95% confidence interval (CI) 2.1 to 3.1 days) than in the control group (4.4 days, 95% CI 3.69 to 5.1 days). Also, the mean time when 75% of the children reached an ABSS below two was also shorter in the experimental group (after three days of treatment) than in the control group (after six days). The certainty of evidence was low, due to unclear risk of bias and serious imprecision of estimates.

2. Change in the severity status of bronchiolitis

Seven trials analysing 482 infants assessed severity of bronchiolitis through clinical scores (Conesa-Segura 2018; Gomes 2012; Gomes 2016; Lopez Galbany 2004; Postiaux 2011; Ramos-Pinto 2021; Van Ginderdeuren 2017). Time of assessment ranged from one to three hours after treatment, Postiaux 2011; Van Ginderdeuren 2017, to discharge from hospital (Conesa-Segura 2018). One ambulatory study conducted the intervention also after emergency department discharge, assessing participants at 15 days postdischarge (Ramos-Pinto 2021). Severity status was assessed with different scales, although in all of them higher values indicated higher severity: Wang clinical score (Gomes 2012; Postiaux 2011; Van Ginderdeuren 2017), Wood score (Gomes 2016), modified Bierman Pierson score (Lopez Galbany 2004), Kristjansson score (Ramos-Pinto 2021), and the ABSS (Conesa-Segura 2018). Results are presented in Figure 4 organised by use of RRT as part of the physiotherapy intervention.

Figure 4. Forest plot of comparison: 1 Slow flow versus control, outcome: 1.1 Severity clinical score.



Overall, slow passive expiratory techniques reduced the severity status of bronchiolitis more than the control (standardised mean difference (SMD) −0.43, 95% CI −0.73 to −0.13; P = 0.03, I^2 = 55%; 7 trials, 434 participants; low-certainty evidence; Analysis 1.1).

In Postiaux 2011, a significant small improvement in the Wang clinical score was observed immediately after the intervention in the group receiving slow flow physiotherapy and salbutamol (3.6 versus 5.1, analysis of variance (ANOVA) P = 0.02), which disappeared two hours later (4.6 versus 3.7, ANOVA P = 0.21). The authors report a "day-to-day baseline improvement in Wang score significantly better [in the CPT group] than that in the control group", but this conclusion is based on within-group tests on a diminishing sample due to discharge of patients ("After 5 days, 6 of the 8 control group patients had been discharged, whereas all 12 of the new-method-CPT group had been discharged").

We could not conduct subgroup analyses by severity, as all trials in this comparison included participants with mild to moderate bronchiolitis.

Subgroup analyses by setting: when considering only interventions delivered in-hospital, slow passive expiratory techniques reduced the severity status of bronchiolitis more than control (SMD −0.37, 95% CI −0.68 to −0.06; P = 0.04, I^2 = 54%; 6 trials, 389 participants). A single study in an ambulatory setting assessed the effect at 15 days after emergency department discharge (end of intervention), and the results suggested that slow passive expiratory techniques may slightly reduce the severity status of bronchiolitis compared to control (mean difference (MD) −0.9, 95% CI −1.6 to −0.3; 1 study, 45 participants).

We conducted a post hoc sensitivity analysis excluding Gomes 2016, as the active intervention in this study was exclusively RRT, and the results corroborated the benefit observed in the main analysis, with no signs of heterogeneity (SMD −0.57, 95% CI −0.80 to −0.35; I^2 = 0%; 6 trials, 334 participants).

Secondary outcomes

1. Respiratory parameters

No data were presented for this outcome.

2. Duration of oxygen supplementation

One trial (236 infants) compared the average hours with oxygen supplementation in the physiotherapy and control groups, which showed no statistically significant differences (Sanchez Bayle 2012). Mean hours of oxygen therapy needed were 49.98 ± 37.10 in the physiotherapy group and 53.53 ± 38.87 in the control group.

3. Length of hospital stay

This outcome was assessed in four trials (345 infants), and only one of them detected statistically significant differences in length of hospital stay between the physiotherapy and control groups. Mean length of stay in Sanchez Bayle 2012 was 4.56 ± 2.07 days in the physiotherapy group and 4.54 ± 1.72 days in the control group. Mean length of stay in Lopez Galbany 2004 was 6.18 days in the physiotherapy group and 5.88 in the control group. Average hospital stay in Postiaux 2011 was 5.3 ± 1.8 days in the physiotherapy group and 6.3 ± 2 days in the control group (Mann-Whitney U test P = 0.25).

Van Ginderdeuren 2017 assessed as primary outcome the time to clinical stability and discharge from hospital, measured as length

of hospital stay in days. Since no explicit criteria were reported on what defined clinical stability, we have reported the data as length of hospital stay. Average time to discharge was significantly shorter in the physiotherapy groups (3.6 ± 1.4 days in assisted autogenic drainage (AAD) and 3.5 ± 1.3 days in intrapulmonary percussive ventilation (IPV)) than in the control group (4.5 ± 1.9 days) (analysis of covariance (ANCOVA) test P = 0.05 for AAD, and P = 0.03 for IPV). There were no differences between physiotherapy groups.

4. Avoidance of hospital admission or emergency visits in ambulatory patients

A single study in outpatients (45 infants) indirectly assessed the need for hospital admission, as it was one criterion for withdrawal of included participants (Ramos-Pinto 2021). Five infants were withdrawn from the study due to hospital admission following clinical worsening (intervention group, n = 2; control group, n = 1) or other clinical problems (gastroenteritis or vascular disease (intervention group, n = 2)).

5. Use of bronchodilators and steroids

One trial including 236 infants recorded the percentages of participants that received salbutamol, ipratropium bromide, or antibiotics, showing no statistical differences between the intervention and control groups (Sanchez Bayle 2012).

6. Parents' impression of physiotherapy benefit

No data were presented for this outcome.

7. Adverse events

Six trials (565 infants) reported on the safety of the procedures explored. The study by Gomes 2016 reported higher number of episodes of nasal bleeding and vomiting in the control aspiration group (28 and 11 episodes, respectively) when compared with the clearance physiotherapy group (1 and 7 episodes, respectively). Van Ginderdeuren 2017 reported no direct complications (respiratory deterioration with oxygen desaturation, bradycardia, vomiting) due to the treatment, although it reported complications due to bronchiolitis severity in 4.3% cases (two in the control group, and one in each physiotherapy group), requiring high-flow oxygen therapy, antibiotics, and/or corticosteroids. We could not pool data for these two trials given that the units of analysis were episodes in one study and participants in the other.

Three in-hospital trials explicitly stated that no adverse events were observed, but there is no definition of the events considered (Conesa-Segura 2018; Postiaux 2011; Sanchez Bayle 2012).

A single study conducted in 45 ambulatory participants explicitly stated that no relevant adverse events were observed in the intervention group, but there is no definition of the events considered (Ramos-Pinto 2021). No mention is made regarding adverse events in the control group. The certainty of the evidence for adverse events was very low.

Comparison 2: slow passive expiratory techniques versus instrumental techniques

Two trials compared passive expiratory techniques (slow passive expiratory techniques) to instrumental physiotherapy (González-Bellido 2020; Van Ginderdeuren 2017). González-Bellido 2020 compared slow flow versus high-frequency chest wall compression (HFCWC), and Van Ginderdeuren 2017 compared assisted autogenic drainage (AAD) and intrapulmonary percussive ventilation (IPV). We did not attempt to pool data, as the instrumental physiotherapy techniques were different.

Primary outcomes

1. Time to recovery

No trials reported estimates of time to recovery between study arms. González-Bellido 2020 reported a higher percentage of participants returning to a normal status by the Wang score at 20 minutes in the slow expiratory group (90.9%) than in the HFCWC group (76.6%). Results at 10 minutes were 77.3% and 53.2%, respectively.

2. Change in the severity status of bronchiolitis

Van Ginderdeuren 2017 found a similar effect on clinical scores between AAD and IPV (MD 0.10, 95% CI −0.17 to 0.37). In González-Bellido 2020, the slow flow intervention had a slightly larger effect on the Wang clinical score than HFCWC (MD 0.14, 95% CI 0.07 to 0.35) at 20 minutes.

Secondary outcomes

1. Respiratory parameters

González-Bellido 2020 reported a minimal reduction in respiratory rate (MD 0.277 breaths/min, 95% CI 0.47 to 1.34) and heart rate (MD 5.87 beats/min, 95% CI 0.72 to 13.2) in the slow flow group compared to the HFCWC group.

2. Duration of oxygen supplementation

No data were presented for this outcome.

3. Length of hospital stay

The two trials were conducted in outpatient participants, therefore this outcome was not applicable.

4. Avoidance of hospital admission or emergency visits in ambulatory patients

No data were presented for this outcome.

5. Use of bronchodilators and steroids

No data were presented for this outcome.

6. Parents' impression of physiotherapy benefit

No data were presented for this outcome.

7. Adverse events

González-Bellido 2020 reported that in the majority of infants (airway clearance techniques group: 42/44, 95.5%; HFCWC group: 39/47, 83.0%), no adverse events were present after 20 minutes. Tachycardia was observed in two infants in the airway clearance group and six in the HFCWC group; petechiae and vomiting were observed in one infant in the HFCWC group.

Comparison 3: forced passive expiratory techniques versus control

Primary outcomes

A summary of results is presented in Summary of findings 2.

1. Time to recovery

Three trials (628 infants) assessed resolution of bronchiolitis in terms of time to recovery, Gajdos 2010; Remondini 2014, and time to clinical stability (Rochat 2010). Overall, there were no significant differences between groups in any of these trials. We did not perform a meta-analysis due to clinical heterogeneity considerations given the differences in how the outcome was defined, assessed, and reported in the individual trials.

In Gajdos 2010, the physiotherapy intervention (forced expiratory technique with assisted cough) had no significant effect on time to recovery as assessed by the logrank test and a Cox regression. The median time to recovery was 2.31 days (95% CI 1.97 to 2.73) for the control group and 2.02 days (95% CI 1.96 to 2.34) for the physiotherapy group (hazard ratio 1.09, 95% CI 0.91 to 1.31; P = 0.33). In Rochat 2010, time to clinical stability, assessed as a primary outcome, was similar for forced expiratory technique and placebo (2.9 ± 2.1 versus 3.2 ± 2.8 days, logrank test P = 0.45).

In Remondini 2014, discharge was conducted when recovery was achieved, defined as a disease severity score respiratory distress assessment instrument (RDAI) ≤ 4 with adequate oxygenation on room air (SpO_2 ≥ 92%). The median time to discharge was three days (range two to five days) in the physiotherapy group, and two days (range one to five days) in the control group, with no statistically significant difference between the two groups (P = 0.408).

The certainty of the evidence was high.

Subgroup analyses by severity: results for the mild-moderate subgroup, Remondini 2014, and the severe subgroup, Gajdos 2010; Rochat 2010, were qualitatively similar, as there were no differences between the intervention and control in any of them.

Subgroup analyses by setting: these could not be conducted, as all trials in this comparison included hospitalised infants.

2. Change in the severity status of bronchiolitis

Two trials (132 infants) assessed severity of bronchiolitis using three non-comparable clinical scores, therefore we did not attempt to pool results.

One trial (103 infants) evaluated severity of bronchiolitis through a clinical score assessing feeding, vomiting, and sleep (Rochat 2010). No differences were observed in daily change in the clinical score between the physiotherapy and the control groups (MD −0.21, 95% CI −0.26 to −0.16); mixed linear models P = 0.37.

One trial (29 infants) compared the addition of two chest physiotherapy techniques (either forced passive expiratory techniques or manual percussion or tapping) to postural drainage. The trial assessed severity of bronchiolitis using the RDAI (Remondini 2014). Both groups showed an RDAI decrease 10 minutes after the intervention (P < 0.001) and maintained these values after 60 minutes. However, no differences were found between groups at 60 minutes (MD −0.13, 95% CI −0.96 to 0.70).

The certainty of evidence was very low.

Subgroup analyses by severity: these could not be conducted because no pooling was attempted.

Subgroup analyses by setting: these could not be conducted because all trials were in hospitalised infants.

Secondary outcomes

One trial comparing the addition of forced passive expiratory physiotherapy to postural drainage did not observe differences in SpO_2 during and after the intervention (Remondini 2014). There were no data on secondary outcomes such as duration of oxygen supplementation, length of hospital stay, and use of bronchodilators and steroids.

1. Respiratory parameters

In Rochat 2010, the rate of improvement of a respiratory score, defined as secondary outcome, only showed a slightly faster improvement of the respiratory score in the prolonged slow expiration technique group when including stethacoustic properties (mixed linear model P = 0.044). No differences were observed in oxygen saturation (SpO_2) (mixed linear models P = 0.85) or respiratory rates (mixed linear models P = 0.24).

2. Duration of oxygen supplementation

No data were presented for this outcome.

3. Length of hospital stay

No data were presented for this outcome.

4. Avoidance of hospital admission or emergency visits in ambulatory patients

All trials were conducted on hospitalised infants, therefore this outcome was not applicable.

5. Use of bronchodilators and steroids

No data were presented for this outcome.

6. Parents' impression of physiotherapy benefit

Remondini 2014 presented data on parents' impression on the benefit of physiotherapy compared to conventional physiotherapy. Parents in both groups reported satisfaction related to improvements of breathing, feeding, and nasal congestion, but no difference was observed between the intervention groups. Gajdos 2010 reported not observing any significant difference in the way the parents rated the influence of physiotherapy on respiratory status (risk ratio (RR) 0.99, 95% CI 0.90 to 1.08; P = 0.89) or comfort (RR 0.99, 95% CI 0.94 to 1.05; P = 0.84).

7. Adverse events

Two trials (599 infants) assessed adverse events or complications. In Gajdos 2010, there were no significant differences between groups in the proportion of children who experienced one episode of bradycardia with desaturation (RR 1.0, 95% CI 0.2 to 5.0; P = 1.00) or without desaturation (RR 3.6, 95% CI 0.7 to 16.9; P = 0.10). Conversely, in the increased exhalation technique physiotherapy group, a higher proportion of children had transient respiratory destabilisation (RR 5.4, 95% CI 1.6 to 18.4; P = 0.002) or vomited during the procedure (RR 10.2, 95% CI 1.3 to 78.8; P = 0.005).

Regarding the physiotherapy technique, in Rochat 2010, complications were defined as concomitant bacterial infection or transfer to the intensive care unit due to respiratory fatigue. The trial authors state that complications related to bronchiolitis

severity were rare and occurred more frequently in the control group, albeit not significantly (12 in the control group, 7 in the intervention group; RR 0.56, 95% CI 0.24 to 1.30; P = 0.21). Also, the trial authors state that no direct complications of physiotherapy such as respiratory deterioration occurred.

Remondini 2014 did not report any adverse events.

For adverse events, the certainty of evidence was high.

Comparison 4: positioning plus percussion and vibration (conventional techniques) versus control

Primary outcomes

1. Time to recovery

No data were presented for this outcome.

2. Change in the severity status of bronchiolitis

Five trials (241 analysed infants) assessed the severity of bronchiolitis by means of clinical scores, with none of them showing statistical differences between groups at day five (Aviram 1992; Bohe 2004; De Córdoba 2008; Nicholas 1999; Webb 1985).

Nicholas 1999 and Webb 1985 used a common clinical score. In Webb 1985, there were no statistically significant differences between groups in relation to the clinical score or to the proportion of infants who remained in hospital at day five. The clinical score was similar in both groups at baseline and on each of the first five days of assessment at the hospital. The median score on admission was 12 (range 4 to 24) in 46 infants in the control group, and 10 (range 4 to 22) in 44 infants in the physiotherapy group. On the fifth day, 18 infants who remained in hospital had a median score of 5 (range 1 to 11) in the control group, and 11 infants had a median score of 6 (range not presented in the original article) in the physiotherapy group. The study also assessed the length of illness, which was not significantly different between groups (Mann-Whitney test) (Mann 1947). The median length of illness was 14 (range 4 to 27) in the control group, and 13 (range 7 to 26) in the physiotherapy group. Nicholas 1999 expressed clinical scores using means but did not report standard deviations (SDs). There were no differences in the admission mean clinical scores (intervention group 9.1 versus control group 10.9) between groups. The trial authors reported that clinical scores did not show any statistically significant differences between groups during the five-day trial. Data were provided on a graph but could not be extracted. Bohe 2004 used a different clinical severity score to the one used in the other two trials. The score at day five or the day of discharge was 3.25 (SD 1.27) in the physiotherapy group, and 3.12 (SD 1.15) in the control group (MD 0.13, 95% CI −0.71 to 0.97). The unpublished trial did not describe the clinical score used, and also failed to show differences between treatment groups (Aviram 1992).

Secondary outcomes

1. Respiratory parameters

Data for respiratory parameters were available in only one of the included trials, assessed immediately after treatment and at 15 minutes (De Córdoba 2008). No significant differences were observed in oxygen saturation levels or in respiratory frequency between treatment groups in their 15-minute results (Kruskal Wallis test) (Kruskal 1952). The amount of aspirated secretions was significantly smaller in the control group than in the intervention groups (P = 0.02, Kruskal Wallis test). Respiratory discomfort was assessed by means of the Silverman-Andersen Questionnaire (Silverman 1956), and significantly improved (P < 0.05, Friedman analysis of variance) post-15 minutes with respect to baseline in the two treatment groups, but not in the control group. It is not clear from the paper whether differences across the groups were tested, but it can be assumed that the lack of data means that there were not significant differences across groups.

2. Duration of oxygen supplementation

Nicholas 1999 found that the mean number of hours with supplemental oxygen was 63 (range 2.3 hours to 128 hours) in the control group compared with 86 (range 36 hours to 148 hours) in the physiotherapy group. Differences were reported as not significant using a non-parametric test.

3. Length of hospital stay

In Bohe 2004, mean length of hospital stay was 4 days (SD 2) in the treatment group, and 3.9 days (SD 1.3) in the control group. There were no statistically significant differences between groups (MD 0.13, 95% CI −1.00 to 1.26). In Nicholas 1999, mean length of hospital stay was 6.6 days (range 2.3 days to 11.5 days) in the control group, and 6.7 days (range 3 days to 9.5 days) in the physiotherapy group. Webb 1985 showed a median length of hospital stay of 4 days (range 1 day to 15 days) in the control group, and 4 days (range 2 days to 11 days) in the physiotherapy group.

4. Avoidance of hospital admission or emergency visits in ambulatory patients

All trials were conducted on hospitalised participants, therefore this outcome was not applicable.

5. Use of bronchodilators and steroids

No data were presented for this outcome.

6. Parents' impression of physiotherapy benefit

No data were presented for this outcome.

7. Adverse events

In Bohe 2004, one case of atelectasis was reported in the control arm. The infant was withdrawn from the trial and assigned to receive chest physiotherapy.

Subgroup analyses

The subgroup analysis by participant severity was confounded by the different chest physiotherapy techniques. Four trials included infants with severe bronchiolitis, corresponding to the comparisons of vibration and percussion (Nicholas 1999), slow passive expiration (Sanchez Bayle 2012), and forced expiration (Gajdos 2010; Rochat 2010). Five trials included infants with moderate bronchiolitis, corresponding to the comparisons of slow passive expiration, Gomes 2012; Lopez Galbany 2004; Postiaux 2011, and vibration and percussion (Bohe 2004; Webb 1985). One trial of vibration and percussion techniques included infants with mild bronchiolitis (De Córdoba 2008). While no formal meta-analysis or test of subgroups could be conducted due to lack of data, it became clear that the evidence for the slow flow chest physiotherapy techniques was unevenly distributed, with slow flow techniques studied in less severe participants than forced expiratory techniques.

For conventional techniques, it was not possible to conduct subgroup analysis by setting, since all trials included hospitalised infants.

Subgroup analysis performed in the included trials

Sanchez Bayle 2012 conducted subgroup analyses of the effect of physiotherapy on length of hospital stay, and duration of oxygen supplementation by subgroups of respiratory syncytial virus (RSV) status. They found statistical differences in the number of hours with oxygen supplementation in the subgroup of RSV-positive infants that received physiotherapy compared to those RSV-positive infants in the control group (mean hours 48.80 ± 37.70 versus 58.68 ± 36.78; P = 0.042, Mann-Whitney test). There were no other statistical differences.

Gajdos 2010 performed subgroup analyses by personal eczema or history of atopy, RSV-positive infection and hypoxaemia at randomisation. There was no statistically significant quantitative interaction on time to recovery between any of these subgroups.

Nicholas 1999 performed a subgroup analysis between infants who had more than 10 points on the baseline clinical score and those with a baseline clinical score below 9.5. There were no differences between the physiotherapy and control groups in this subgroup analysis.

Webb 1985 reported that there were no differences between treatments in daily scores or length of illness in the subset of participants with some degree of collapse/consolidation on chest X-rays.

DISCUSSION

Summary of main results

This review included 17 trials (1679 infants) exploring the efficacy of five physiotherapy techniques (vibration and percussion (conventional techniques), slow passive expiratory techniques, forced passive expiratory techniques, and rhinopharyngeal retrograde inspiratory technique), compared to control (conventional medical care with no physiotherapy intervention) or other respiratory physiotherapy techniques, in hospitalised or non-hospitalised infants with acute bronchiolitis not under mechanical ventilation.

The slow expiratory techniques showed a mild-to-moderate significant benefit in change of disease severity, which was higher when combined with RRT. However, there was no significant effect on length of hospital stay, except for in one study (Van Ginderdeuren 2017), nor for oxygen requirements. Regarding RRT applied in infants with acute moderate bronchiolitis (Gomes 2016), a decrease in severity clinical score was observed compared to nasal aspiration. Instrumental techniques showed improvements in severity score immediately after the intervention, although less than slow passive expiratory techniques. For conventional or forced expiratory techniques, no effect was observed in any variable.

In this 2022 update, we reported a meta-analysis with positive effects produced by the airways clearance techniques slow expiratory techniques alone or combined with RRT in severity score of infants with acute bronchiolitis. These techniques should be considered in infants with acute moderate bronchiolitis as a co-adjuvant intervention along with medical treatment, due to a direct effect on airway obstruction resulting in improved mucus transportability.

In analysing the results according to the type of technique used, it is clear that two airways clearance techniques are not beneficial (conventional and forced expiratory). However, slow passive expiratory techniques, alone or in combination, could provide a relief in disease severity.

The included trials did not report severe adverse events for most of the techniques used. However, Gajdos 2010 observed a significant risk of vomiting (RR > 10) and respiratory instability (RR > 5) with forced expiratory technique. Few or no complications related to bronchiolitis severity were observed in trials using slow passive expiratory techniques (Conesa-Segura 2018; González-Bellido 2020; Postiaux 2011; Ramos-Pinto 2021; Rochat 2010; Sanchez Bayle 2012). For infants with nasal obstruction, no nasal bleeding was observed and fewer vomiting episodes were reported with RRT compared to nasal aspiration (Gomes 2016).

Overall completeness and applicability of evidence

Based on the evidence provided in this review, the following four points must be considered when airway clearance techniques are used for infants with acute bronchiolitis.

First, infants with severe acute bronchiolitis are unlikely to benefit from chest physiotherapy due to their critical respiratory status (distress, airways inflammation, etc.) and severe symptoms (exhaustion, apnoea, cyanosis, poor fluid intake, etc.) or possible comorbidities (Meissner 2016). In infants with mild acute bronchiolitis, respiratory symptoms should rapidly decrease, and chest physiotherapy helps to accelerates this. Infants who benefit the most are those with a moderate exacerbation, as airway clearance techniques have an impact in reducing the severity of acute bronchiolitis (Conesa-Segura 2018; Gomes 2012; Lopez Galbany 2004; Ramos-Pinto 2021; Van Ginderdeuren 2017). Chest physiotherapy should therefore target infants with moderate exacerbation of acute bronchiolitis.

Second, only slow passive expiratory techniques, alone or in combination with RRT, can improve the severity score compared to control infants with moderate bronchiolitis (Conesa-Segura 2018; Gomes 2012; Lopez Galbany 2004; Postiaux 2011; Ramos-Pinto 2021; Van Ginderdeuren 2017). Similar results, but not as high, were observed using instrumental techniques, González-Bellido 2020; Van Ginderdeuren 2017, or RRT, Gomes 2016, when applied alone, producing a decrease in length of hospital stay in one trial (Van Ginderdeuren 2017). However, some techniques such as forced passive expiratory techniques have adverse effects and should be avoided (Gajdos 2010).

Third, related to the setting where the intervention should be used, two trials were conducted in non-hospitalised infants (i.e. outpatients) and achieved positive results in infants with moderate acute bronchiolitis (González-Bellido 2020; Ramos-Pinto 2021). For the first time, chest physiotherapy for acute bronchiolitis has not been linked to the hospital environment, probably because the infants had moderately severe acute bronchiolitis, and chest physiotherapy was effective in this non-clinical setting.

Fourth, a new chest physiotherapy intervention, RRT, which removes nasopharynx secretions, was explored (Gomes 2016). This is a common site of mucus obstruction in bronchiolitis (Norris

2018). When comparing RRT to nasal aspiration, this non-invasive technique demonstrated an immediate decrease in severity score, and had few adverse events and complications in infants with moderate acute bronchiolitis.

Certainty of the evidence

The certainty of the evidence in the review varied, depending on the comparison being considered. While there is high-certainty evidence for forced expiration techniques, the certainty of evidence is low for slow passive expiration techniques, and very low for vibration and percussion. The GRADE assessments rely heavily on the risk of bias of the trials, and the imprecision of their results, mainly due to small sample sizes. For adverse effects, there were concerns regarding indirectness of assessments for trials that were unclear on how the adverse effects were assessed.

The high-certainty evidence for forced expiration techniques in infants with severe bronchiolitis stems from the overall low risk of bias of the trials, the large number of participants included, and the consistency of the results of the trials. Although the three trials assessed recovery with two different measures (time to recovery and time to clinical stability), the results were homogeneous and led to similar conclusions of no effect of the physiotherapy techniques. One of the trials had a very large sample size and good methodological quality, and was designed to detect a 20% decrease in time to recovery, assessed eight-hourly (Gajdos 2010). Since this adequately powered trial was negative, our confidence in the lack of effect observed with this physiotherapy technique is high. Also, the negative results are consistent in all the assessed outcomes, including respiratory parameters, which are more sensitive to the treatment and do not show a statistical benefit. There are also negative results in length of hospital stay, a less relevant outcome since it is a crude measure of length of illness, and is sensitive to unrelated factors (i.e. hospital discharge practices, day of the week, parental wishes, etc.).

The low-certainty evidence for the slow flow techniques in moderate/severe cases stems from the unclear risk of bias, moderate sample sizes, and methodological limitations in the adverse effects assessment in the included studies. The included trials used different measures of clinical severity, and some of them presented incomplete data. Although most data on clinical efficacy were positive overall, most of the effects were not explored for a long time period, except for in Ramos-Pinto 2021, and could therefore be considered as transient. The largest trial in the comparison (and second-largest trial in the review) did not perform an a priori sample size estimation, thus we cannot assess the power of the trial or the potential lack of power of the conclusions (Sanchez Bayle 2012). The very low certainty of evidence on the safety of slow passive expiration techniques stems from doubts regarding how safety was assessed in the included trials. The safety issues observed with forced expiratory techniques are related to the intrinsic characteristics of forcing expiration, and it could be argued that these issues would be minor or non-existent in the slow passive expiration procedures due to their gentler nature.

The very low-certainty evidence for vibration and percussion techniques stems from the high risk of bias and small sample sizes in the included studies. However, the consistency between trials in showing a lack of effect and the external reports on safety of the procedures strengthen a negative conclusion (Beeby 1998; Chalumeau 2002; Harding 1998; Knight 2001).

A methodological issue in the trials was the implementation of a valid placebo. Because the majority of the trials had a non-intervention group, usually control groups received standard care, and the researchers would have been expected to establish an outcome assessment procedure that prevented bias. Again, this was effectively and imaginatively established in Conesa-Segura 2018, Gajdos 2010, Gomes 2016, Postiaux 2011, Sanchez Bayle 2012, and Van Ginderdeuren 2017. Gajdos 2010 and Sanchez Bayle 2012 compared chest physiotherapy with nasal suctioning or postural changes, respectively. Postiaux 2011 administered an aerosol composed of albuterol (3 mL) and hypertonic saline (3% NaCl) in both groups and added the slow passive expiration techniques to the intervention group. Conesa-Segura 2018 applied similar actions, hypertonic saline nebulisation (3% NaCl) plus nasopharynx aspiration. The same nasopharyngeal aspiration was carried out in the Gomes 2016 control group. Van Ginderdeuren 2017 applied the more original placebo intervention by bouncing infants from the control group on a fit ball, as a sort of "shaking" technique. However, none of these alternatives were shown to have an impact on the overall trial results, as this lack of placebo alternative will usually overestimate the results, favouring the intervention.

It is important to consider that a limitation of the majority of included trials was that they did not analyse the effectiveness of the techniques in terms of duration of oxygen supplementation, time to recovery or other treatments used, such as hypertonic saline nebulisation. Due to their importance in terms of disease improvement, future research should take these variables into account.

Potential biases in the review process

To avoid biases in the review process, we applied robust methods for searching, study selection, data collection, and risk of bias assessment. To guarantee the comprehensiveness of the search, we sought both published and unpublished trials and contacted trial authors where possible to gather additional information about unpublished trials. While pooling of data was not possible for some interventions, conventional techniques, we have considered the potential impact of this and have performed a careful assessment of individual trials. In addition, we performed a rigorous risk of bias assessment of the included trials.

Agreements and disagreements with other studies or reviews

The first publication of this review in 2005, Perrotta 2005, prompted the recommendation that chest physiotherapy based on vibration and percussion should not be used routinely in hospital settings (BGT 2005; Ralston 2014a; SIGN 2006). Recently, some systematic reviews and clinical guidelines have been published on this topic based on the same evidence, and reached similar conclusions to the previous Cochrane Review (Roqué i Figuls 2016a) (systematic reviews: Bourke 2010; Castro-Rodriguez 2015; González 2010b; Kirolos 2020; Schechter 2007; Wainwright 2010; and clinical guidelines: Ministerio de Salud Chile 2013; NICE 2021; Norris 2018; PREDICT 2019; Ralston 2014a). Chest physiotherapy does not have to be routinely recommended, except when infants present with comorbidities or with nasopharyngeal obstructions. Due to the findings of our Cochrane Review and the previously mentioned evidence (Roqué i Figuls 2016a), in France, two trials were conducted to analyse the use of forced expiratory technique

(AFE in French) in clinical settings. They observed a decrease in chest physiotherapy prescription (Branchereau 2013; HAS-FR 2019), and a recommendation to not systematically prescribe chest physiotherapy based on forced expiratory technique for ambulatory infants (Verstraete 2014). As a consequence, this updated review includes the most recent RCTs; introduces two new interventions, instrumental and nasopharyngeal techniques; and remains the main source of evidence on chest physiotherapy for acute bronchiolitis.

AUTHORS' CONCLUSIONS

Implications for practice

Conventional chest physiotherapy (postural drainage plus percussion and vibration techniques) has not been shown to improve the severity of bronchiolitis, and is associated with adverse effects. For these reasons, conventional techniques must not be used in clinical practice for infants with bronchiolitis.

Results for chest physiotherapy using passive flow-oriented expiratory techniques (which includes both forced expiratory techniques and slow flow techniques) have differed. For the forced expiratory technique, no improvements on severity scores, nor a reduction in time to recovery or length of hospital stay, was observed. However, for slow expiratory techniques, a mild to moderate significant benefit in severity score - higher when combined with rhinopharyngeal retrograde technique - was shown. Furthermore, in only one study evaluating slow passive expiratory techniques, a significant decrease in length of hospital stay was observed. No benefits in oxygen requirements were reported with any intervention.

For rhinopharyngeal retrograde technique applied in infants with moderate bronchiolitis, a decrease in severity score was observed in comparison to nasal aspiration, but not in infants with severe bronchiolitis. Instrumental techniques showed moderate improvements in severity score immediately after intervention.

By considering the severity of the disease, it is notable that only moderate acute bronchiolitis infants could benefit from chest physiotherapy, slow expiration, rhinopharyngeal, or instrumental techniques applied in-hospital or ambulatory, as shown in two trials. This is important to take into account when considering these techniques as a co-adjuvant to medical treatment.

There is high-certainty evidence that forced expiratory techniques in infants with severe bronchiolitis do not improve their health status and can lead to severe adverse effects. Consequently, there are no arguments in favour of routine use of these techniques as standard clinical practice for hospitalised infants with severe bronchiolitis. Few or no complications were observed when applying slow expiratory techniques, nor for instrumental techniques. For those infants with nasal obstruction, some adverse effects were observed when applying the rhinopharyngeal technique, but fewer than with nasal aspiration.

There is low-certainty evidence that slow flow techniques may temporarily decrease severity of disease in infants with moderate acute bronchiolitis, and for this reason we conclude that, under clinical judgement, these techniques may be considered in specific situations to improve respiratory performance.

Implications for research

Based on the results of this review, it seems clear that conventional and forced expiratory techniques will not change the course of the disease in hospitalised infants with severe bronchiolitis. Further trials using these techniques in this population should therefore not be a research priority.

There is evidence to suggest that passive slow expiratory technique may result in a mild to moderate improvement in severity of the disease, when compared to control. This evidence comes mostly from infants with moderately acute bronchiolitis treated in a in-hospital setting; however, the available evidence is of low certainty, and further trials with more rigorous methodology are needed to reach stronger conclusions. On the other hand, the evidence is very limited with regard to infants with severe bronchiolitis, and in infants with moderate severity bronchiolitis treated in ambulatory settings; these two populations should therefore be further studied. Other questions that remain unanswered relate to the minimum duration and dose of physiotherapy that are needed to achieve persistent benefits. Any research conducted on this topic should include a specific and thorough assessment of adverse effects and reported infant satisfaction and harms.

Currently, the evidence regarding new physiotherapy techniques such as rhinopharyngeal retrograde technique or instrumental physiotherapy is very scarce, and more trials are needed to determine the effectiveness of the these techniques, alone or in combination with slow passive expiratory techniques. Other questions to be clarified refer to the role of rhinopharyngeal retrograde technique in acute bronchiolitis with nasal obstruction in comparison to nasal aspiration or nasopharyngeal suctioning.

We recommend exploring the effects of these techniques in non-hospitalised infants with moderate bronchiolitis. At present, only two trials have been conducted in non-hospitalised infants, and the generalisation of the review's body of evidence to non-hospitalised infants may not be straightforward due to differences in the health conditions and severity of disease between hospitalised and ambulatory infants.

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The following people conducted the editorial process for this 2022 update.

- Sign-off Editors (final editorial decision): Mark Jones (Bond University, Australia); Mieke van Driel (The University of Queensland, Australia).
- Managing Editors (provided editorial guidance to authors, edited the review, selected peer reviewers, collated peer-reviewer comments): Liz Dooley (Bond University, Australia); Fiona Russell (Bond University, Australia).
- Contact Editor (assessed peer-review comments and recommended an editorial decision): Johannes van der Wouden (Amsterdam UMC, Vrije Universiteit, Amsterdam, Netherlands).

- Statistical Editor (provided comments): Robert S Ware (Griffith University, Australia).
- Copy Editor (copy-editing and production): Lisa Winer, Cochrane Copy Edit Support.

Peer reviewers (provided comments and recommended an editorial decision):

- Clinical/content review: Francis Gilchrist (Keele University and Staffordshire Children's Hospital at Royal Stoke, UK).
- Consumer review: Mohamed A Gouda (Menoufia University, Egypt); Eman Sobh (Al-Azhar University, Cairo, Egypt; College of Medical Rehabilitations Sciences, Medina, Saudi Arabia).
- Methods review: Leslie Choi (Evidence Synthesis Development Editor, Cochrane Central Executive Team, UK).
- Search review: Justin Clark (Institute for Evidence-Based Healthcare, Bond University, Australia); Jo Platt (Information Specialist Cochrane Cochrane Gynaecological, Neuro-Oncology and Orphan Cancers Review Group, UK).

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Aviram 1992

Study characteristics	
Methods	Randomised, single-blinded controlled trial Clinical scoring was performed in a blinded manner.
Participants	50 young infants with acute bronchiolitis, paired by age and severity of disease. Diagnostic criteria not described. Country: Israel. Age range 1 to 5 months. There was no information on percentage of RSV+ participants.
Interventions	**Group 1:** chest physiotherapy. Although there is no information on the physiotherapy technique applied, it is assumed to be based on vibration and percussion (N = 25). **Group 2:** no intervention (N = 25) All participants were treated with fluids, oxygen (when SpO_2 in room < 92%), and received inhaled salbutamol every 6 hours.
Outcomes	Length of stay in hospital Improvement in clinical score (12 hours) (Tal 1983) Changes in SpO_2
Notes	Unpublished study. No information on funding. Authors confirmed trial unpublished (July 2010) and provided additional information. Personal communication: the decision to discharge was based on improvement of the infant to a score of < 5 and no need for oxygen. There was no difference between the 2 groups.

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

Aviram 1992 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	No information available.
Allocation concealment (selection bias)	Unclear risk	No information available.
Blinding (performance bias and detection bias) All outcomes	Unclear risk	"Clinical scoring was done by a physician who was blinded to the [chest physiotherapy] therapy" Personal communication: "Patient's condition was monitored using our clinical score by one of two physicians, twice a day, blinded to the yes or no chest physiotherapy done by a third person, who was blinded to the scores."
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	50 infants were randomised and analysed.
Selective reporting (reporting bias)	Unclear risk	No information available.
Other bias	High risk	Trial reported as abstract, no peer review of full publication.

Bohe 2004

Study characteristics	
Methods	Randomised, open controlled trial
Participants	Infants admitted to the hospital with a clinical diagnosis of acute bronchiolitis defined as acute respiratory tract infection, preceded or simultaneous to fever and/or rhinitis, plus tachypnoea, wheezing, and increased respiratory effort. Country: Argentina. N = 32 participants randomised and participants analysed: 16 allocated to the control group and 16 to the intervention arm. Mean age 2.8 months, and 78.1% of participants were positive for RSV. There was no information on the percentage of RSV+ participants or participants with atelectasis/consolidation at baseline or during the trial.
Interventions	**Group 1:** drainage, percussion, vibration, and nasopharyngeal aspiration twice a day (N = 16) **Group 2:** nasopharyngeal aspiration (N = 16) All participants received nebulised B2 adrenergic and inhaled and intravenous corticoids.
Outcomes	Primary outcome: clinical score with range 0 to 12 (Wood 1972), scoring 0 to 3 to heart rate, respiratory rate, auscultation, use of accessory muscles. Assessment at discharge Secondary outcome: length of stay (days)
Notes	1 participant in the control group developed atelectasis at day 4 and was withdrawn and received chest respiratory physiotherapy. Children were assessed every evening up to discharge or day 5. No information on funding
Risk of bias	

Bohe 2004 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participant allocation was random, by means of concealed allocation according to admission number, independently assigned by the hospital admission centre.
Allocation concealment (selection bias)	Low risk	Allocation was described as concealed.
Blinding (performance bias and detection bias) All outcomes	High risk	Study described as open.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	32 participants were randomised and analysed. A child included in Group 2 presented right basal atelectasis by 4th day of hospitalisation; he received respiratory physiotherapy and was excluded from the trial. It is not clear how the data were treated.
Selective reporting (reporting bias)	Unclear risk	Not described
Other bias	Low risk	No other biases identified.

Conesa-Segura 2018

Study characteristics	
Methods	Randomised, double-blind controlled clinical trial
Participants	Children under the age of 2 years, admitted to hospital for acute viral bronchiolitis, absence of congenital cardiopathy, and no contraindication for thoracic physiotherapy techniques. Diagnostic criteria were not reported; however, they cited a study (Scarfone RJ. Controversies in the treatment of bronchiolitis. Curr Opin Pediatr 2005; 17: 62–6). Country: Spain. N = 77 participants randomised and 71 participants analysed: 42 allocated to the respiratory physiotherapy group, and 35 to the control group. Mean age was 2.9 months (range 1.8 to 5.4). There was no information on percentage of RSV+ participants.
Interventions	**Group 1:** respiratory physiotherapy group. Slow expiration technique + coughing + retrograde rhinopharyngeal unclogging (forced inspiratory manoeuvre) + nasal and oral aspiration in order to remove secretions. The treatment was given once a day during the stay in infant's unit, and total duration of treatment was about 15 minutes (N = 39). **Group 2 (control group):** no physiotherapy (N = 32) All participants received hypertonic saline nebulisation, and the nasopharynx content was aspirated. No drug was prohibited during study and they were prescribed freely by paediatricians.
Outcomes	Primary outcome: Acute Bronchiolitis Severity Scale score and O_2 saturation, recorded shortly after each intervention during the stay and at medical discharge, and the hospital stay. Higher values indicate increased severity. Secondary outcomes: subjective opinion of parents or tutors at the end of treatment
Notes	All infants were assessed daily at 3 time points: baseline (at 8.00 a.m.) and 10 minutes and 2 hours after physiotherapy intervention in Groups 1 and 2, until discharge. They were also evaluated at discharge.

Conesa-Segura 2018 *(Continued)*

Authors report no funding.

ClinicalTrials.gov identifier: NCT02458300

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A researcher did a simple randomisation by assigning participants to either the respiratory physiotherapy group or the control group (Macro!RNDSEQ for SPSS Statistics. Generation of Random Sequences [computer program]. V2011.09.09. Randomisation seed = –1987653.97)
Allocation concealment (selection bias)	Low risk	The allocation was concealed by the primary researcher.
Blinding (performance bias and detection bias) All outcomes	Low risk	Evaluating paediatricians, parents, and statistician were unaware of the group codes.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	6 out of 77 participants excluded from analysis. Flow of participants described. Number of participants excluded from analysis unlikely to impact on results or conclusions.
Selective reporting (reporting bias)	Unclear risk	Study protocol was published in ClinicalTrials.gov, and methods agree with publication. However, publication presents oxygen saturation as a primary outcome, when it was not reported as such in the protocol, and omits a secondary outcome established in protocol (subjective opinion). Regardless, we considered that these changes did not bias reporting.
Other bias	Low risk	No other biases identified.

De Córdoba 2008

Study characteristics

Methods	Randomised, open controlled trial Participants were allocated by opaque, sealed envelopes.
Participants	Children below 2 years admitted to the hospital and emergency department, with clinical and radiological diagnosis of acute viral bronchiolitis, presenting with bronchial hypersecretion (pulmonary auscultation). Country: Brazil. N = 24 participants randomised, 19 participants analysed: 5 in Group 1, 8 in Group 2, and 6 in Group 3. Exclusions due to haemodynamic instability (2), heart disease (1), non-invasive mechanical ventilation (1), prematurity (1) Mean age: 93 days in Group 1, 131 days in Group 2, 125 days in Group 3. There was no information on percentage of RSV+ participants or participants with lung collapse/consolidation at baseline or during the trial.
Interventions	**Group 1:** vibration + postural drainage + bronchial aspiration in dorsal decubitus (N = 5) **Group 2:** percussion + postural drainage + bronchial aspiration in dorsal decubitus (N = 8) **Group 3:** bronchial aspiration in dorsal decubitus (N = 6)

De Córdoba 2008 *(Continued)*

	Postural drainage for 5 minutes in each decubitus (right and left lateral randomly chosen) + bronchial aspiration in dorsal decubitus. All participants received nasotracheal aspiration with saline solution.
Outcomes	The primary outcome is not clear. Outcomes assessed were: saturation of oxygen pulse, cardiac frequency, respiratory frequency, Silverman-Andersen score of respiratory discomfort (Silverman 1956), amount of inhaled secretion.
Notes	Treatment was delivered once. Outcomes were assessed immediately after treatment and after 15 minutes. No information on funding

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Low risk	Participants were randomised by means of opaque, sealed envelopes.
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	High risk	24 randomised participants and 5 exclusions described with reasons, but not the groups to which they belonged: 2 haemodynamic instability, 1 heart disease, 1 non-invasive mechanical ventilation, and 1 preterm baby. Results are presented for 19 participants.
Selective reporting (reporting bias)	Unclear risk	Not described
Other bias	Low risk	No other biases identified.

Gajdos 2010

Study characteristics

Methods	Randomised, double-blind controlled trial All interventions were administered with the physiotherapist staying alone with the infant in a room with a covered window pane. The therapists were not involved in the evaluation of time to recovery.
Participants	Children aged 15 days to 24 months with first acute bronchiolitis and indication of hospitalisation, and 1 or more of the following criteria at admission: toxic aspect; apnoea or cyanosis; respiratory rate > 60/minute; pulse oxymetry < 95%; alimentary intake < 2/3 of the needs. Bronchiolitis was diagnosed on the basis of a history of upper respiratory tract infection and clinical findings consistent with bronchiolitis, including wheezing or wheezing with crackles and respiratory distress. Country: France. N = 496 participants randomised and analysed: 246 allocated to the control group and 250 to the intervention group. Mean age 2 months, range 1.3 to 3.9 months. The control group presented with a higher proportion of RSV+ infants than the intervention group (76.4% vs 73.3%), as well as the proportion of cases of lung atelectasis diagnosed on chest X-ray (12.9% vs 7.6%). Survival analyses of time to recovery were adjusted for prognostic baseline covariates, including atelectasis at randomisation and RSV infection.

Gajdos 2010 *(Continued)*

Interventions	**Group 1:** chest physiotherapy with increased exhalation technique plus assisted cough plus nasopharyngeal aspiration (N = 246) **Group 2:** nasopharyngeal aspiration (N = 250) Increased exhalation technique involved the generation of synchronised thoracic-abdominal movement by the hands of the physiotherapist at the beginning of expiration with 1 hand on the thorax, meanwhile with the other on the abdomen, centred on the umbilicus, the physiotherapist applied an abdominal counterweight. The manoeuvre began at the end of the inspiratory plateau and was pursued until the end of expiration, according to the infant's thoraco-pulmonary compliance and up to his or her chest wall and lung resistance limits. The procedure was repeated until meeting auscultation-efficacy criteria (decrease or disappearance of wheezing and/or increase of rhonchi), but did not last longer than 10 to 15 minutes. The procedure was stopped in the case of respiratory status aggravation. If no spontaneous coughing occurred, coughing could be triggered by pressure on the suprasternal notch. All interventions were administered 3 times a day.
Outcomes	Primary outcome: time to recovery, defined in the study protocol as verifying, for at least 8 hours in a row, the following requirements: pulse oxymetry >= 95% AND normal feeding AND specific respiratory distress score lower than 1 as described in the protocol AND normal respiratory rate Secondary outcomes: safety of the forced expiratory technique; comparison of pulse oxymetry before/after chest physiotherapy; quality of life scale
Notes	ClinicalTrials.gov identifier: NCT00125450 Study received funding from governmental organisations.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"random allocation computer generated with SAS software packages in advance by the biostatistician", "permutation blocks with a block size of four"
Allocation concealment (selection bias)	Low risk	"physiotherapist opening a sealed sequentially numbered envelope" "block size of four that was not mentioned to the physicians involved in the patient recruitment"
Blinding (performance bias and detection bias) All outcomes	Low risk	"all paediatric department staff, parents and guardians were blind to treatment assignment." "Those involved in the evaluation of primary outcome or in the decision of the co interventions were blinded to group assignment." "The treatment was performed by the physiotherapist staying alone with the infant, in a room with a covered window pane"
Incomplete outcome data (attrition bias) All outcomes	Low risk	"Analysis was performed on an intent-to-treat basis and all patients included in the study were analysed, including the two lost to follow-up (one in each group)"
Selective reporting (reporting bias)	Low risk	Protocol available and consistent with report.
Other bias	Low risk	No other biases identified.

Gomes 2012

Study characteristics	
Methods	Randomised, single-blinded controlled trial Assessors were blinded to the treatment groups.
Participants	Infants aged from 28 days to 24 months, previously healthy, with a clinical diagnosis of acute bronchiolitis infection and positive outcome of RSV in nasopharyngeal aspirate detected by immunofluorescence technique. Country: Brazil. N = 30 participants randomised, 30 participants analysed at baseline, 20 analysed at 48 hours, 17 analysed at 72 hours Mean age 125 days. % RSV+ 100%
Interventions	**Group 1:** new physiotherapy group received prolonged slow expiration (slow passive and progressive expiration from the functional residual capacity into the expiratory reserve volume) and clearance rhinopharyngeal retrograde (forced inspiratory manoeuvre) (N = 10) **Group 2:** conventional physiotherapy group received vibrations, expiratory compression, modified postural drainage only in the lateral decubitus position, and clapping (N = 10) **Group 3:** control group received suction of the upper airways (N = 10). The control group was only assessed at admission, and afterwards followed the standard chest physiotherapy regimen in the hospital; we did not consider this group in the review.
Outcomes	Primary outcome: Wang's clinical score. Higher values indicate increased severity. Secondary outcomes: transcutaneous PCO_2
Notes	Assessments performed at 2 hours, 48 hours, and 72 hours after admission and again 1 hour prior to discharge. ClinicalTrials.gov identifier: NCT00884429 No information on funding Authors contacted and provided information (21 March 2014).

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Infants were randomised by using sealed opaque envelopes containing the instructions to be followed in each of three groups"
Allocation concealment (selection bias)	Low risk	"Infants were randomised by using sealed opaque envelopes containing the instructions to be followed in each of three groups"
Blinding (performance bias and detection bias) All outcomes	Low risk	"Assessors were blinded to the treatment groups. These raters were trained specifically for this assessment. The time spent caring for children was similar in all groups and parents were unaware of their child's group allocation."
Incomplete outcome data (attrition bias) All outcomes	Low risk	3 participants lost at 72 hours (1 in new physiotherapy group and 2 in conventional physiotherapy group) due to hospital discharge.
Selective reporting (reporting bias)	Unclear risk	Study protocol was published on ClinicalTrials.gov, and methods agree with publication. The protocol describes the study as single-blind (investigator), although the publication states that parents were also blinded to the intervention assignment.

Gomes 2012 *(Continued)*

Other bias	Low risk	No other biases identified.

Gomes 2016

Study characteristics	
Methods	Randomised, open controlled clinical trial
Participants	Children ≤ 12 months old with a clinical diagnosis of acute viral bronchiolitis, and hospitalised. Children were excluded if 1 of the following criteria was present: history of lung disease related to prematurity (bronchopulmonary dysplasia), heart disease, chronic lung diseases (cystic fibrosis), bronchopneumonia or associated pneumonia, unstable haemodynamics (ARDS or sepsis), subcutaneous oedema, admission to the ICU, tracheostomy, or the need for mechanical ventilation and associated neurological disease. Country: Brazil. N = 114 participants randomised and 100 participants analysed. Mean age in months by group: Group 1: 4.80 (SD 2.92); Group 2: 4.78 (SD 2.98). RSV was identified in 68% of cases in Group 1 and 54% in Group 2.
Interventions	**Group 1:** nasopharyngeal aspiration group: 3 times a day for 5 minutes, in early morning, early afternoon, and evening, separated by approximately 4 h. A sterile aspiration catheter connected to an extension was introduced; the technician introduced it through the nasal orifice of the participant. A negative (vacuum) pressure promoted the suction of secretion from the airways (N = 50). **Group 2:** clearance group: retrograde rhinopharyngeal clearance technique performed 3 times a day for 5 minutes, in early morning, early afternoon, and evening, separated by approximately 4 h (N = 50). All participants received a 0.9% physiological solution instillation before the procedure.
Outcomes	Primary outcome: chest retractions, wheezing, nasal bleeding, vomit episodes Secondary outcomes: heart rate, respiratory rate, oxygen saturation (SpO_2) with oxygen use, SaO_2 in room air, and Wood clinical score. Wood clinical severity score includes the evaluation of heart rate, breathing frequency, chest retractions, presence of wheezing, pulmonary auscultation, and cyanosis. Each variable is graded from 0 (absent) to 3 (severe), and the final score is categorised into 3 levels: mild (1 to 3), moderate (4 to 7), and high (8 to 14). Higher values indicate increased severity.
Notes	In both groups, there were 3 evaluations on the same day. No information on funding ClinicalTrials.gov identifier: NCT02460614

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participants were randomly assigned using computer software.
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	Open-label study

Gomes 2016 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	High risk	It is not clear how many participants were assessed (in Table 2, data were only reported for 42 of 50 participants in the aspiration group and 40 of 50 participants in the clearance group). There is no clear information for the remaining outcomes: oxygen saturation, breathing frequency, heart rate, and clinical score.
Selective reporting (reporting bias)	Unclear risk	Study protocol was published on ClinicalTrials.gov, and methods agree with publication.
Other bias	Low risk	No other biases identified.

González-Bellido 2020

Study characteristics	
Methods	Randomised, open controlled clinical trial
Participants	91 non-hospitalised infants with mild to moderate acute viral bronchiolitis were randomised.
Interventions	**Group 1:** airway clearance techniques (20 min of prolonged slow expiration and provoked cough) (N = 44) **Group 2:** high-frequency chest wall compression (HFCWC) for 15 minutes (N = 47) In both groups, all children received 1 inhalation with 4 mL hypertonic saline (NaCl 3%), nebulised at a flow of 8 L/min over 10 min (Phillips, Murrysville, Pennsylvania).
Outcomes	Primary outcomes: Wang clinical severity score; oxygen saturation Secondary outcomes: use of BD; respiratory rate (bpm); heart rate (bpm); SaO_2 20 min post-treatment; sputum volume (mL) Adverse events, including the presence of petechiae, tachycardia, and vomiting, were monitored during both treatments and recorded at baseline and at 10 min and 20 min.
Notes	One of the authors, Dr Donadio, is supported in part by Coordenaçao de Aperfeiçoamento de Pessoal de Nıvel Superior and Conselho Nacional de Desenvolvimento Cientifico e Tecnologico, Brasil. No other authors claimed any conflicts of interest.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Assignment numbers were generated by simple random sequences using R 5.3.1"
Allocation concealment (selection bias)	Low risk	"An independent investigator allocated subjects to the airway clearance techniques or HFCWC group in a concealed manner, using sealed opaque envelopes."
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Open study. Nevertheless, "a medical evaluator, blinded to the group allocation, was responsible for all evaluations in both groups".

González-Bellido 2020 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	All randomised participants were included in the analysis. However, there was an unexpectedly large number of exclusions due to lack of consent to participate.
Selective reporting (reporting bias)	Low risk	Main outcome and time points in published study agree with ClinicalTrials.gov registration (NCT03835936).
Other bias	Low risk	None detected.

Lopez Galbany 2004

Study characteristics	
Methods	Randomised, single-blind controlled trial
Participants	Pilot study enrolled 30 hospitalised infants less than 1 year old with RSV+ bronchiolitis. Country: Spain. N = 32 participants randomised, 32 participants analysed: 16 allocated to the control group and 16 to the intervention group. There was no information on age or percentage of RSV+ participants.
Interventions	**Group 1:** forced expiratory technique for 10 minutes, single daily session during the first 5 days of hospitalisation **Group 2:** no intervention
Outcomes	Severity clinical score (Bierman Pierson modified score) (Bierman 1974; Tal 1983). Higher values indicate increased severity. Length of stay
Notes	Unpublished study No information on funding Authors confirmed trial unpublished (July 2010).

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	No information
Allocation concealment (selection bias)	Unclear risk	No information
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Unpublished data report blinded data assessment.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information

Lopez Galbany 2004 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No information
Other bias	High risk	Trial reported as abstract, no peer review of full publication.

Nicholas 1999

Study characteristics	
Methods	Randomised, open controlled trial Participants were randomly allocated to control and treatment groups using a random sequence number.
Participants	Infants admitted to the hospital with a clinical diagnosis of acute bronchiolitis and with respiratory distress severe enough to require nasogastric tube feeding or intravenous fluids N = 50 participants randomised and analysed: 24 were allocated to control group and 26 to treatment group. Mean age of control group: 3.2 (range 0.4 to 8.3); intervention group 2.4 (range 0.4 to 6.9). RSV+: control 79%, intervention 85%
Interventions	**Group 1:** vibration and postural drainage techniques twice a day (N = 26) **Group 2:** no intervention (N = 24) In the physiotherapy arm, the infant was treated on the physiotherapist's knee, percussion and vibration lying on right side, lying on the left side, and sitting; suction performed after on each side, if necessary, until clear; no oxygen required during treatment. Modifications were allowed if infant could not tolerate the procedure. Oxygen was allowed depending on infant tolerability.
Outcomes	Primary outcome: validated clinical score (Dick 1991) with values 0 to 20, assigning scores 0 to 2 to heart rate, respiratory rate, blood gases, rhinitis, hyperinflation, use of accessory muscles, recession, cough, wheeze, crackles Secondary outcomes: length of stay (days); provision of inspired oxygen; requirement for nasogastric feeding; oxygen saturation
Notes	The study ended at 5 days or if the infant was transferred to the ICU. Authors did not report SD. No information on funding

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"random sequence number generated by the Medical Statistics Unit of the University of Edinburgh"
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias)	Unclear risk	50 participants were randomised and assessed, although 1 child was excluded from the trial after being admitted to the ICU. It is not clear how these data

Nicholas 1999 *(Continued)*

All outcomes		were treated. Saturation of oxygen pulse assessments comprised 2 excluded children who were not assessed for clinical outcomes.
Selective reporting (reporting bias)	Unclear risk	Not described
Other bias	Low risk	No other biases detected.

Postiaux 2011

Study characteristics	
Methods	Randomised, single-blinded controlled trial Both of the paediatric evaluators were blinded to the applied treatment and goals. Physiotherapists in charge of administering the treatments were instructed to ignore the results of each evaluation until the end of the study. The participants' parents were unaware of the group to which their child had been assigned. In both groups, the periods of time spent in the room were identical, so outside observers were blinded to the applied treatment.
Participants	Hospitalised infants less than 1 year of age presenting with acute RSV bronchiolitis and a clinical Wang score >= 3. Country: Belgium. N = 20 infants randomised and analysed: 8 allocated to the control group and 12 to the intervention group. Mean age: 4.19 months. % RSV+: 100%
Interventions	**Group 1:** 3% hypertonic saline solution and salbutamol (HS therapy) (n = 8, totalling 27 sessions) **Group 2:** HS therapy followed by 1 session of 10 to 15 minutes of prolonged slow expiration technique and coughing provoked (n = 12, totalling 31 sessions). Sessions lasted 30 minutes.
Outcomes	Primary outcome: Wang's clinical score (respiratory rate, wheezing, retraction, general appearance). The maximum Wang score is 12; higher score indicates a worse condition. Secondary outcomes: SaO_2; heart rate
Notes	Outcomes were evaluated at time point 0 before the session, time point 30 at end of the session, and time point 150. Authors report no conflict of interest/funding.

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Low risk	"Both of our paediatrician evaluators were blinded to the applied treatment and goals"; "Physiotherapists in charge of administering the treatments were instructed to ignore the results of each evaluation until the end of the study. The patient' parents were unaware of the group in which their child was included. In both groups the periods of time spent in the room were identical, so outside observers were blinded to the applied treatment."

Postiaux 2011 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	20 participants were randomised and assessed.
Selective reporting (reporting bias)	Unclear risk	No information available.
Other bias	Low risk	No other biases identified.

Ramos-Pinto 2021

Study characteristics	
Methods	Randomised, single-blind controlled clinical trial
Participants	Non-hospitalised children under 2 years of age, diagnosed with mild-moderate acute viral bronchiolitis. Exclusion criteria: severe bronchiolitis; need for admission to the inpatient department; chronic pulmonary or neuromuscular diseases, congenital heart diseases, trisomy 21 or other congenital malformations; no contraindication for thoracic physiotherapy techniques A total of 45 children completed the study (n = 28, IG) (n = 17, CG). Mean age was 11.5 months (SD 6.7). There was no information on percentage of RSV+ participants.
Interventions	**Group 1:** outpatient respiratory physiotherapy group. Slow expiration technique + coughing + retrograde rhinopharyngeal unclogging (forced inspiratory nasal manoeuvre). 20 min/session, 5 sessions during 1st week, 3 alternating sessions during 2nd week (total 8 sessions) **Group 2:** control group, no physiotherapy. Both groups received similar recommendations on general support measures and were medicated, as needed.
Outcomes	Primary outcome: respiratory status, assessed by Kristjansson Respiratory Score (KRS) on days 15 and 7 Secondary outcome: peripheral oxygen saturation and adverse events
Notes	Authors report no conflict of interest/funding.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was conducted by permuted blocks.
Allocation concealment (selection bias)	Low risk	Allocation envelopes were stored in sequentially numbered (from 1 to 6), opaque, sealed envelopes, prepared by a person not involved in the study, and opened after the inclusion of a new case.
Blinding (performance bias and detection bias) All outcomes	Unclear risk	A double-blind assessment was not possible, as both physiotherapist and parents were aware of the intervention.
Incomplete outcome data (attrition bias)	High risk	80 cases randomised, only 45 finished the study. Differing rates of attrition in control and intervention groups (52.6% and 23.8% by lack of adherence)

Ramos-Pinto 2021 *(Continued)*

All outcomes		
Selective reporting (reporting bias)	Low risk	Main outcome and time points in published study agree with ClinicalTrials.gov registration (NCT04260919).
Other bias	Low risk	No other biases identified.

Remondini 2014

Study characteristics	
Methods	Randomised controlled trial
Participants	Hospitalised infants younger than 1 year with a clinical diagnosis of bronchiolitis. Country: Brazil. N = 29 infants randomised into 2 groups. Group 1 = 16 infants, 48 sessions; Group 2 = 13 infants, 35 sessions. The trial authors considered the participant ready to be discharged from the study when they presented a lower disease severity score (RDAI score ≤ 4) associated with adequate oxygenation on RA (SpO_2 ≥ 92%). Participants that presented with congenital heart diease, neuropathy, underlying lung disease, indication for ventilatory support, or RDAI score ≤ 4 associated to SpO_2 ≥ 92% were excluded. Mean age was 5.81 months. There was no information on percentage of RSV+ participants.
Interventions	**Group 1:** underwent postural drainage associated with expiratory acceleration flow (EAF) and tracheal aspiration (N = 13) **Group 2:** underwent postural drainage associated with tapping or percussion and tracheal aspiration (N = 16) The total number of sessions was 83: 48 in the conventional group and 35 in the forced expiratory group. The physiotherapist in charge of the infant determined the number of sessions according to the disease severity. The number of sessions ranged from 1 to 4 a day.
Outcomes	Primary outcome: Respiratory Distress Assessment Instrument (RDAI) score system and oxygen saturation (SpO_2) Secondary outcomes: time required to discharge, and parents' perception of treatment
Notes	Participants were assessed before, 10 minutes after, and 60 minutes after the physical therapy intervention, by the same therapist.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described

Remondini 2014 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	4 participants were excluded because of refusal of parents to accept AEF manoeuvre. Participants were assessed before, 10 minutes after, and 60 minutes after the physical therapy intervention.
Selective reporting (reporting bias)	Unclear risk	No information available.
Other bias	Low risk	No other biases identified.

Rochat 2010

Study characteristics	
Methods	Randomised open clinical trial
Participants	Infants <= 1 year admitted with diagnosis of RSV+ bronchiolitis during 2 consecutive RSV seasons (2005 to 2006 and 2006 to 2007). Country: Switzerland. N = 103 children randomised, 99 analysed. 51 allocated to physiotherapy and 52 to control. Mean age was 109 days (3.9 months). RSV test positive: 74% intervention, 75.5% control
Interventions	**Group 1:** physiotherapy group received 2 daily physiotherapy sessions at least 2 hours after feeds (prolonged slow expiratory technique obtained by slow manual pressure over the abdomen, exerted at the start of the expiratory phase down to the residual volume and maintained for 2 to 3 respiratory cycles; manual vibration exerted at the start of the expiratory phase; induced cough) plus same treatment as control group (N = 51) **Group 2:** control group received rhinopharyngeal suctioning after instillation of normal saline solution if needed; minimal handling; oxygen to achieve $SpO_2 \geq 92\%$ and fractionated meals (N = 52) Topical bronchodilators and steroids were not routinely used. Nasal drops such as xylometazoline were often employed to decrease nasal congestion. Antibiotics were administered when concomitant bacterial infection was suspected (prolonged fever, otitis media, and increased white cell count).
Outcomes	Primary outcome: time to clinical stability, defined by feeding more than 50% of the required amount, absence of vomiting, undisrupted sleep, and $SpO_2 \geq 92\%$ for more than 10 hours Secondary outcomes: change in clinical state, measured by a general score made of 3 well-being items (feeding, vomiting, and quality of sleep); change in respiratory state, measured by a respiratory score made of 7 items (respiratory rate, pulse oximetry oxygen saturation SaO_2, presence and severity of retractions, adventitious respiratory sounds, presence of vesicular murmur, thoracic distension); occurrence of complications (such as transfer to the ICU)
Notes	Study received funding from governmental organisations. Outcomes assessed daily at a fixed time point prior to physiotherapy sessions. Authors contacted and provided information (March 2014).

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	"Randomisation list in blocks of random length (8, 10 or 12) by the study epidemiologist, not involved in the clinical phase of the study."

Rochat 2010 *(Continued)*

Allocation concealment (selection bias)	Low risk	"Randomisation was done by the attribution of a number contained in a sealed opaque envelope opened following the inclusion consent. Envelopes were prepared according to a randomisation list in blocks of random length (8, 10 or 12) by the study epidemiologist, not involved in the clinical phase of the study (TP)."
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Open trial. Nevertheless, "All children underwent daily clinical evaluations at a fixed time point prior to the physiotherapy sessions when allocated to the group with CP. Evaluations were performed by a study physiotherapist who was different from the physiotherapist administering the treatment".
Incomplete outcome data (attrition bias) All outcomes	Low risk	103 randomised infants, 4 of whom were later excluded (1 in physiotherapy, 3 in control) for the following reasons: parental withdrawal of consent, erroneous initial diagnosis and direct admission to intensive care, or age > 12 months. Results presented for the 99 remaining eligible infants.
Selective reporting (reporting bias)	Unclear risk	An abstract presented to a scientific meeting in 2010 focuses its conclusions on the daily improvement of a severity score, while the published paper reports time to clinical stability as the primary outcome. Nevertheless, we believe this change does not introduce bias into the results since both outcomes were related and non-significant.
Other bias	Low risk	No other biases identified.

Sanchez Bayle 2012

Study characteristics	
Methods	Randomised, single-blinded, controlled trial Participants were randomised before checking of inclusion criteria and signing of informed consent, leading to the exclusion of 40 randomised participants not meeting the criteria, and 16 participants that refused consent because of blinding of intervention received. Only the physiotherapists were aware of the allocation groups of the infants. Parents, doctors, and nurses were unaware of the treatment allocations during the study.
Participants	Infants < 7 months with a first episode of acute bronchiolitis diagnosed by McConnochie 1993 criteria, admitted in a paediatric hospital during 2 consecutive winter seasons. Country: Spain. 293 children where randomised (149 to physiotherapy and 144 to control) and 236 participants were analysed. Mean age was 2.77 months. RSV test positive: 66% intervention, 67% control
Interventions	**Group 1:** physiotherapy group received 2 daily physiotherapy sessions of 10 minutes (prolonged slow expiratory technique obtained by slow manual pressure over the abdomen, exerted at the start of the expiratory phase down to the residual volume and maintained for 2 to 3 respiratory cycles; manual vibration exerted at the start of the expiratory phase; induced cough) plus oxygen therapy until SpO_2 >= 94% (N = 136) **Group 2:** control group received postural changes plus oxygen therapy until SaO_2 >= 94% (N = 100) All interventions were administered twice a day.
Outcomes	Primary outcome: duration of oxygen supplementation, length of hospital stay Secondary outcomes: salbutamol use, ipratropium bromide use, antibiotics use, adrenaline use, pneumonia

Sanchez Bayle 2012 *(Continued)*

Notes	Outcomes were assessed at discharge. Authors reported no conflicts of interest/funding. Authors contacted and provided information (March 2014).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random number table used.
Allocation concealment (selection bias)	Unclear risk	No information provided.
Blinding (performance bias and detection bias) All outcomes	Low risk	"Only the physiotherapists were aware of the allocation group of the infants", "The placebo group received postural changes, so parents, doctors and nurses couldn't guess the allocation group"
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	236 analysed participants of 293 initially recruited. 40 initially recruited participants (10 in treatment and 30 in control) did not meet inclusion criteria. The unequal distribution may be related to selection bias.
Selective reporting (reporting bias)	Unclear risk	No information provided.
Other bias	Low risk	No other biases identified.

Van Ginderdeuren 2017

Study characteristics

Methods	Randomised controlled clinical trial
Participants	Children under 2 years of age, hospitalised with a first episode of bronchiolitis. Bronchiolitis was diagnosed on the basis of clinical findings, including wheezing or wheezing with crackles and respiratory distress. Children were eligible within 24 h of admission if they presented as a mild to moderate bronchiolitis with a Wang clinical severity score ≥ 3 and ≤ 8. Country: Belgium. N = 103 participants randomised and 93 participants analysed: 34 allocated to the assisted autogenic drainage group, 33 to the intrapulmonary percussive ventilation group, and 36 to the bouncing control group. Mean age in days by group: 121 (SD 118) in Group 1; 135 (SD 132) in Group 2; 160 (SD 143) in Group 3. Percentages of RSV+ participants were 71% in Group 1, 74% in Group 2, and 74% in Group 3.
Interventions	**Group 1:** assisted autogenic drainage (AAD). Treatment began at least 2 h after the latest inhalation and feeds, 1 session daily of 20 minutes (N = 31). **Group 2:** intrapulmonary percussive ventilation (IPV). Treatment began at least 2 h after the latest inhalation and feeds, 1 session daily. Each child received 4 cycles of 5 min of IPV (N = 31). **Group 3 (control group):** bouncing at low amplitude (4 to 6 cm), a gentle up-and-down movement on a physiotherapy ball; 1 session daily of 20 minutes (N = 31). AAD and IPV were combined with bouncing, and if no spontaneous coughing occurred, coughing was triggered every 5 min by a gentle pressure on the suprasternal notch.

Van Ginderdeuren 2017 *(Continued)*

	All participants received 3 inhalations daily with 0.5 mL salbutamol dissolved in 4 mL hypertonic (3%) saline (NaCl 3%), nebulised over 10 min with a Sidestream Nebuliser at a flow of 6 L/min. Rhinopharyngeal rinsing with normal saline was applied to all participants if needed. Oxygen supplementation was administered if SaO_2 was ≤ 92%. Orogastric feeding was offered to children spontaneously ingesting less than 50% of their daily needs.
Outcomes	Primary outcome: mean time to discharge, measured as length of hospital stay in days Secondary outcomes: the impact of the treatment and the daily improvement with a validated clinical and respiratory severity score (Wang score), heart rate, and oxygen saturation (SaO_2)
Notes	Outcomes were assessed before, after, and 1 h after treatment. Authors reported no conflicts of interest/funding. ClinicalTrials.gov identifier: NCT02126748

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Children were randomised to the different treatment modalities by the attribution of a computer-generated number (Randomisation.com, 2011), using the method of randomly permuted blocks.
Allocation concealment (selection bias)	Low risk	Each number was contained in a sealed, opaque envelope opened by the physiotherapist after inclusion. Envelopes were prepared by a physiotherapist not involved in the clinical phase of the study.
Blinding (performance bias and detection bias) All outcomes	Low risk	The publication describes the study as blinded in performance ("All pediatric department staff and parents were blind to treatment assignment") and outcome detection ("[assessors] were blinded to the applied treatment").
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	10% of losses, similarly distributed across arms
Selective reporting (reporting bias)	Unclear risk	Study protocol was published in ClinicalTrials.gov, and methods agree with publication. However, the protocol describes the study as "single blind (outcome assessor)", while the publication states that paediatric department staff and parents were also blinded.
Other bias	Low risk	No other biases identified.

Webb 1985

Study characteristics

Methods	Randomised, open, controlled trial
Participants	Infants admitted with a clinical diagnosis of acute bronchiolitis. Unreported diagnostic criteria. Country: UK. N = 90 participants randomised and analysed: 46 allocated to the control group and 44 to the intervention arm

Webb 1985 *(Continued)*

	Mean age 46 months (range 0.5 to 15). 69% had RSV; 36% had a first-degree family history of atopy; 66% had smokers in the household; 24.5% had some degree of atelectasis/consolidation on chest X-rays.
Interventions	**Group 1:** chest physiotherapy comprising standard techniques applied by a trained paediatric physiotherapist. Chest percussion was performed with a cupped hand for 3 minutes in each of 5 postural drainage positions followed by assisted coughing or gentle oropharyngeal suction twice a day (N = 44). **Group 2:** no intervention (N = 46)
Outcomes	Primary outcome: clinical score, with values 0 to −30, assigning scores 0 to 3 to heart rate, respiratory rate, hyperinflation, use of accessory muscles, recession, rhinitis, wheeze, cough, crepitations and rhonchi Secondary outcome: length of stay (days), total length of illness (days)
Notes	Clinical assessment of severity illness made at a fixed time each day for 5 days. At hospital discharge, parents were asked to maintain a symptom record diary, and children were reviewed in outpatient clinics after 2 weeks. Authors did not report mean and SD of the mean. When contacted, the trial author was unable to provide the mean and SD of each parameter because the raw data were no longer available. Results were expressed as median values and range. No information on funding

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	High risk	"Strictly speaking, [assessments] could not be 'blind' with respect to treatment status though in practice that status was not obvious at each assessment"
Incomplete outcome data (attrition bias) All outcomes	High risk	90 analysed participants, but it is not clear how many were randomised, or if there was any attrition of participants
Selective reporting (reporting bias)	Unclear risk	Not described
Other bias	Low risk	No other biases identified.

ADD: assisted autogenic drainage
AEF: forced expiratory technique (augmentation expiratoire du flux)
ARDS: acute respiratory distress syndrome
AVB: acute viral bronchiolitis
BD: bronchodilation
bpm: beats per minute
CG: control group
EAF: eosinophilic angiocentric fibrosis
ELISA: enzyme-linked immunosorbent assay
HFCWC: high-frequency chest wall oscillation
HS: hypertonic saline solution and salbutamol

ICU: intensive care unit
IG: intervention group
IPV: intrapulmonary percussive ventilation
NaCl: sodium chloride
PCO_2: partial pressure of carbon dioxide
RDAI: respiratory distress assessment index
RSV: respiratory syncytial virus
SaO_2: oxygen saturation in room air
SD: standard deviation
SpO_2: oxygen saturation with oxygen use

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Belcastro 1984	Controlled clinical trial of osteopathic intervention compared with postural drainage and bronchodilator therapy
Bernard-Narbonne 2003	Uncontrolled intervention study
Castro 2014	To be included, patients had to present an acute wheezing episode, which is not necessarily correlated to bronchiolitis.
Evenou 2017	Observational study
Postiaux 2004	Uncontrolled intervention study
Pupin 2009	Controlled clinical trial: no participants randomised
Quitell 1988	Uncontrolled intervention study
Sebban 2017	Observational study
Sebban 2019	Published in a predatory journal

Characteristics of ongoing studies *[ordered by study ID]*

ACTR12608000601336

Study name	Comparison of effectiveness between Anglo-Saxon chest physiotherapy techniques and European chest physiotherapy techniques in infants diagnosed with acute bronchiolitis
Methods	Blinded randomised clinical trial
Participants	Infants aged between 0 and 24 months, with a recent acute bronchiolitis diagnostic attested by a physician and a posteroanterior thorax X-ray incidence
Interventions	**Group 1:** Anglo-Saxon chest physiotherapy techniques: aerosol therapy, vibration, postural drainage, percussion and induced cough **Group 2:** European chest physiotherapy techniques: aerosol therapy, ELPr (French: expiration length prolonged-passive, slow expiration) induced cough
Outcomes	Wang severity clinical score, hospitalisation period, pulse oxymetry, heart rate
Starting date	1 July 2008 (start of enrolment)

ACTR12608000601336 *(Continued)*

Contact information	Alice Bella Lisbôa. Rua Abolição, 1827, Swift, Campinas-SP, Brazil. Phone: +55 19 32373878 +55 19 92475175. E-mail: bella.lisboa@gmail.com
Notes	

NCT02708147

Study name	Impact of respiratory physiotherapy in children with bronchiolitis in the first 2 years of life
Methods	Randomised clinical trial, parallel, open
Participants	52 children up to 2 years of age, with medical diagnostic for 1st or 2nd episode of bronchiolitis and who were healthy 3 days before the current diagnosis of bronchiolitis
Interventions	**Group 1:** forced expiratory physiotherapy + conventional treatment **Group 2:** conventional treatment, only contact with physician/paediatrician and maybe drugs prescription
Outcomes	1. Computerised lung sounds 2. Wang severity scale
Starting date	15 March 2016
Contact information	Alda S Marques, PhD +351234 372 462 amarques@ua.pt
Notes	clinicaltrials.gov/ct2/show/NCT02708147

NCT02853838

Study name	Chest physiotherapy in infants between 0 and 12 months old with acute bronchiolitis SRV(+)
Methods	Randomised, parallel open trial
Participants	Children up to 12 months years of age, both genders, with a diagnosis of acute bronchiolitis, RSV+ in direct immunofluorescence assay, a Wang clinical severity score ≥ 4 points, not receiving supplementary oxygen and with no contraindications to physiotherapy (N = 204)
Interventions	**Group 1:** slow flow physiotherapy and standard care: prolonged slow expiration + provoked coughing **Group 2 (control):** vibration All participants received standard care consisting of nasopharyngeal suction, oxygen therapy, fluids administration, and 0.5% adrenaline nebulisation.
Outcomes	Primary outcome: Wang clinical score assessed at 48 h after baseline

NCT02853838 *(Continued)*

	Secondary outcomes: hours of supplementary oxygen, peripheral blood oxygen level, heart rate, respiratory rate, wheezing, rib cage retractions, general clinical condition, transfer to high complexity unit
Starting date	March 2015
Contact information	Patricio Gomolan Gonzalez, Universidad del Desarrollo, Chile
Notes	clinicaltrials.gov/ct2/show/NCT02853838

NCT03738501

Study name	Slow expiratory technique to improve alimentation in children with bronchiolitis (BRONCHIOL-EAT)
Methods	Randomised clinical trial with parallel assignment and triple masking (participant, investigator, outcomes assessor)
Participants	42 children under 12 months hospitalised for bronchiolitis, with a chest physiotherapy prescription, and bronchial obstruction confirmed by physician and respiratory physiotherapist
Interventions	**Group 1:** chest physiotherapy where airway clearance technique is slow expiratory technique. Experimental group will also benefit for standard medical and non-pharmacological care (e.g. standard treatment). **Group 2:** standard treatment: medical treatment, health education for parents, rhinopharyngeal clearance using isotonic saline solution, advices
Outcomes	1. Food ingestion 2. Sleep quality 3. Oxygen saturation 4. Respiratory rate 5. Heart rate 6. Respiratory distress
Starting date	13 November 2018
Contact information	Yann Combret, PT, MSc +33786952577 yann.combret@gmail.com
Notes	clinicaltrials.gov/ct2/show/NCT03738501

NCT03753802

Study name	Multicentre, randomised controlled trial: evaluation of the effects of respiratory physiotherapy, placebo-controlled, in infants with moderate acute bronchiolitis
Methods	Randomised, quadruple-blind, controlled clinical trial
Participants	Infants aged 3 to 24 months, suffering a first or second episode of acute viral bronchiolitis of moderate severity (Wang's score > 3 and < 9), treated on an outpatient basis (N = 168)

NCT03753802 *(Continued)*

Interventions	**Group 1:** chest physiotherapy: chest physiotherapy treatment using slow extended and passive expiratory manoeuvres **Group 2 (control):** no physiotherapy
Outcomes	Primary outcomes: change of the Wang's Respiratory score between day 4 and day 1, time to improvement (up to 4 days), defined as an increase of 10 points from the QUALIN score (for child under 24 months of age) compared to the initial score. The QUALIN total score quotes the quality of life of the child from −68 to +68, with a negative score meaning that the child has a poor general health condition and quality of life, and a positive score meaning that the child has a good general health condition and quality of life. Secondary outcome measures: change in oxygen saturation
Starting date	December 2019
Contact information	Aurore Trebuchet, Réseau Kinésithérapie Bronchiolite Essonne, France
Notes	clinicaltrials.gov/ct2/show/NCT03753802 clinicaltrials.gov/ProvidedDocs/02/NCT03753802/Prot_SAP_ICF_002.pdf

NCT04553822

Study name	Mucociliary clearance techniques in moderate bronchiolitis
Methods	Randomised clinical trial, parallel, single masking (outcomes assessor)
Participants	165 participants between 2 and 12 months of age, with medical diagnosis of a first episode of acute viral bronchiolitis of moderate degree of severity (Wang clinical severity score ≥ 4 and ≤ 8; modified Wood-Downes Scale score ≥ 4 and ≤ 5; acute bronchiolitis severity scale ≥ 5 and ≤ 9; Hospital Sant Joan de Déu scale ≥ 6 and ≤ 10; ReSVinet Scale ≥ 7 and ≤ 13), had not previously received respiratory physiotherapy since diagnosis, and oxygen saturation (SaO_2) ≥ 94%
Interventions	**Group 1:** assisted autogenous drainage group (DAA) **Group 2:** prolonged slow expiration (ELPr) **Group 3:** nebulisation with 4 mL Muconeb 3% hypertonic serum, for 8 minutes in a Philips vibrating mesh nebuliser
Outcomes	Primary outcome measures: 1. Modified Wang clinical severity scale [Time Frame: 48 hours] Secondary outcome measures: 1. Wood-Downes scale modified by Ferres [Time Frame: 48 hours] 2. Acute Bronchiolitis Severity Scale [Time Frame: 48 hours] 3. Scale of the Sant Joan de Déu Hospital [Time Frame: 48 hours] 4. ReSVinet Scale [Time Frame: 48 hours]
Starting date	1 July 2022
Contact information	Juan Nicolas Mr Cuenca Zaldívar +34 639 96 29 35

NCT04553822 *(Continued)*	
	nicolas.cuenca@salud.madrid.org
Notes	clinicaltrials.gov/ct2/show/NCT04553822

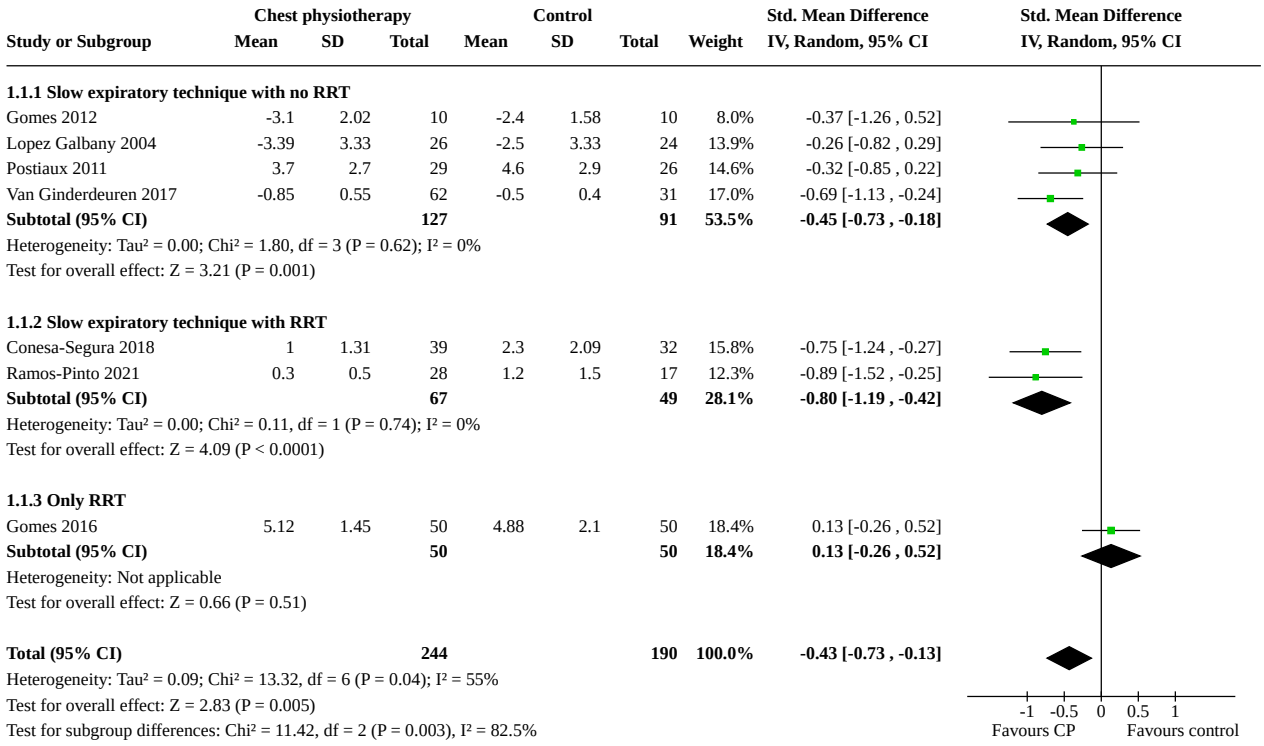
RSV: respiratory syncytial virus
SaO_2: oxygen saturation

DATA AND ANALYSES

Comparison 1. Slow passive expiratory technique versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Severity clinical score	7	434	Std. Mean Difference (IV, Random, 95% CI)	-0.43 [-0.73, -0.13]
1.1.1 Slow expiratory technique with no RRT	4	218	Std. Mean Difference (IV, Random, 95% CI)	-0.45 [-0.73, -0.18]
1.1.2 Slow expiratory technique with RRT	2	116	Std. Mean Difference (IV, Random, 95% CI)	-0.80 [-1.19, -0.42]
1.1.3 Only RRT	1	100	Std. Mean Difference (IV, Random, 95% CI)	0.13 [-0.26, 0.52]

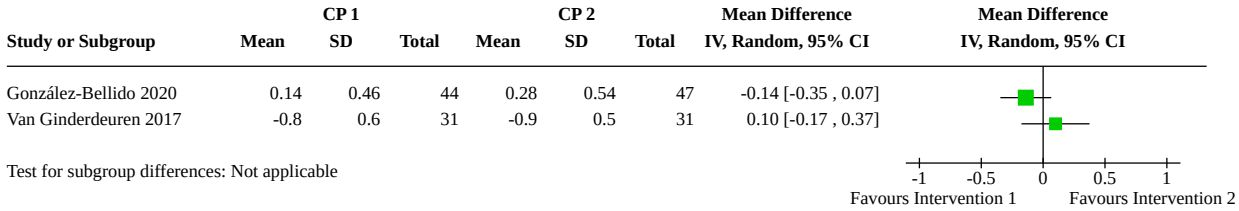
Analysis 1.1. Comparison 1: Slow passive expiratory technique versus control, Outcome 1: Severity clinical score



Comparison 2. Slow passive expiratory techniques versus instrumental techniques

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Severity clinical score	2		Mean Difference (IV, Random, 95% CI)	Subtotals only

Analysis 2.1. Comparison 2: Slow passive expiratory techniques versus instrumental techniques, Outcome 1: Severity clinical score

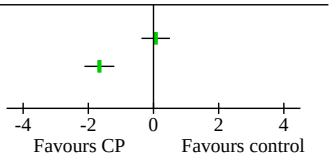


Comparison 3. Forced passive expiration technique versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 Severity clinical score	2		Std. Mean Difference (IV, Fixed, 95% CI)	Totals not selected

Analysis 3.1. Comparison 3: Forced passive expiration technique versus control, Outcome 1: Severity clinical score

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Std. Mean Difference IV, Fixed, 95% CI
Remondini 2014	3.26	1.96	35	3.13	1.81	48	0.07 [-0.37 , 0.50]
Rochat 2010	-0.12	0.126	50	0.09	0.125	49	-1.66 [-2.12 , -1.20]



ADDITIONAL TABLES

Table 1. Chest physiotherapy studies grouped by the applied technique

	Chest physiotherapy technique (EG)	Participant disease severity	Setting	Comparison (CG)	N randomised
De Córdoba 2008	Conventional[a] vibration + percussion + PD	Mild	Hospital	Percussion + PD (CG1) Suctioning (CG2)	24 (19 analysed) EG: 5 CG1: 8 CG2: 6
Bohe 2004	Conventional: vibration + percussion + PD	Moderate	Hospital	No intervention[b] + suctioning	32 EG: 16 CG: 16
Nicholas 1999	Conventional: vibration + percussion + PD	Severe	Hospital	No intervention	50 EG: 24 CG: 25
Aviram 1992	Conventional: vibration + percussion + PD	Not reported	Hospital	No intervention	50 EG: 25 CG: 25
Webb 1985	Conventional: vibration + percussion + PD	Moderate	Hospital	No intervention	90 EG: 44

Table 1. Chest physiotherapy studies grouped by the applied technique *(Continued)*

					CG: 46
Ramos-Pinto 2021	Slow expiration technique and rhinopharyngeal retrograde clearance technique + provoked cough	Mild-moderate	Outpatient	No intervention	45 EG: 28 CG: 17
González-Bellido 2020	Slow expiration technique + induced cough	Mild-moderate	Outpatient	High-frequency chest wall compression	91 EG: 44 CG: 47
Conesa-Segura 2018	Slow expiration technique + coughing + rhinopharyngeal retrograde technique + nasal and oral aspiration	Mild-moderate (93%)	Hospital	No intervention	77 EG: 42 CG: 35
Van Ginderdeuren 2017	Slow expiration technique (assisted autogenic drainage) + bouncing + induced cough + salbutamol 0.5 mL (EG1) Intrapulmonary percussive ventilation + bouncing + induced cough + salbutamol 0.5 mL (EG2)	Moderate	Hospital	Bouncing + salbutamol 0.5 mL	103 EG1: 34 EG2: 33 CG: 36
Sanchez Bayle 2012	Slow expiration technique	Severe	Hospital	Postural changes (sham)	293 EG: 149 CG: 144
Gomes 2012	Slow expiration technique + nasal drainage	Moderate	Hospital	Conventional (CG1) Suctioning (CG2)	30 EG: 10 CG1: 10 CG2: 10
Postiaux 2011	Slow expiration technique + induced cough + albuterol 3 mL + 3% NaCl	Moderate	Hospital	Albuterol 3 mL + 3% NaCl	20 EG: 12 CG: 8
Lopez Galbany 2004	Slow expiration technique	Moderate	Hospital	No intervention	32 EG: 16 CG: 16
Gomes 2016	Rhinopharyngeal retrograde technique + 0.9% physiological solution	Mild-moderate (72%)	Hospital	Nasopharyngeal aspiration + 0.9% physiological solution	114 (100 analysed) EG: 50 CG: 50

Table 1. Chest physiotherapy studies grouped by the applied technique *(Continued)*

Remondini 2014	Conventional physiotherapy (postural drainage + percussion and tracheal aspiration) + forced expiration technique	Mild-moderate	Hospital	Conventional	29 EG: 16 CG: 13
Rochat 2010	Slow + forced expiration technique + induced cough	Severe	Hospital	No intervention	103 EG: 51 CG: 52
Gajdos 2010	Forced expiration technique + assisted cough	Severe	Hospital	Nasal suctioning	496 EG: 246 CG: 250

[a]Conventional: conventional chest physical therapy (postural drainage, percussion, vibration, and suctioning).
[b]No intervention: usual medical care (bronchodilators + corticoids + oxygen therapy if needed + nasal suctioning).
Abbreviations: CG: control group; EG: experimental group; NaCl: hypertonic saline solution; PD: postural drainage

APPENDICES

Appendix 1. MEDLINE (Ovid) search strategy

1 exp Bronchiolitis/
2 bronchiolit*.tw.
3 exp Respiratory Syncytial Viruses/
4 Respiratory Syncytial Virus Infections/
5 (repiratory syncytial virus* or rsv).tw.
6 or/1-5
7 exp Physical Therapy Modalities/
8 (chest adj2 (physiotherap* or physical therap*)).tw.
9 Drainage, Postural/
10 (postural adj2 drainage*).tw.
11 Percussion/
12 (chest* adj3 percuss*).tw.
13 Vibration/
14 vibrat*.tw.
15 (chest* adj3 shak*).tw.
16 directed cough*.tw.
17 forced exhalation.tw.
18 forced expiration.tw.
19 Breathing Exercises/
20 breathing exercise*.tw.
21 or/7-20
22 6 and 21

Appendix 2. MEDLINE (Ovid) In-Process and Other Non-Indexed Citations

1 bronchiolit*.tw.
2 (repiratory syncytial virus* or rsv).tw.
3 (chest adj2 (physiotherap* or physical therap*)).tw.
4 (postural adj2 drainage*).tw.
5 (chest* adj3 percuss*).tw.
6 vibrat*.tw.
7 (chest* adj3 shak*).tw.
8 directed cough*.tw.

9 forced exhalation.tw.
10 forced expiration.tw.
11 breathing exercise*.tw.
12 (physiotherap* or physical therap*).tw.
13 1 or 2
14 or/3-12
15 13 and 14

Appendix 3. EMBASE (Elsevier) search strategy

21. #6 AND #20
20. #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19
19. (breathing NEAR/2 exercise*):ab,ti
18. 'breathing exercise'/de
17. 'forced exhalation':ab,ti OR 'forced expiration':ab,ti
16. 'directed coughing':ab,ti
15. (chest* NEAR/3 shak*):ab,ti
14. vibrat*:ab,ti
13. 'vibration'/de
12. (chest* NEAR/3 percuss*):ab,ti
11. 'percussion'/de
10. 'postural drainage':ab,ti
9. 'postural drainage'/de
8. (physiotherapy NEAR/4 chest):ab,ti
7. 'physiotherapy'/exp
6. #1 OR #2 OR #3 OR #4 OR #5
5. 'respiratory syncytial virus':ab,ti OR 'respiratory syncytial viruses':ab,ti OR rsv:ab,ti
4. 'respiratory syncytial virus infection'/de
3. 'respiratory syncytial pneumovirus'/de
2. bronchiolit*:ab,ti
1. 'bronchiolitis'/exp

Appendix 4. CINAHL (EBSCO) search strategy

S24 S6 and S23
S23 S21 or S22
S22 S7 or S8 or S9 or S10 or S11 or S12 or S13
S21 S14 or S15 or S16 or S17 or S18 or S19 or S20
S20 TI breathing exercise* or AB breathing exercise*
S19 (MH "Breathing Exercises+")
S18 TI ("forced exhalation" or "forced expiration") or AB ("forced exhalation" or "forced expiration")
S17 TI directed N3 cough* or AB directed N3 cough*
S16 TI chest N3 shak* or AB chest N3 shak*
S15 TI vibrat* or AB vibrat*
S14 (MH "Vibration")
S13 TI chest N3 percuss* or AB chest N3 percuss*
S12 (MH "Percussion")
S11 TI "postural drainage" or AB "postural drainage"
S10 TI chest N3 "physical therapy" or AB chest N3 "physical therapy"
S9 TI chest N3 physiotherap* or AB chest N3 physiotherap*
S8 (MH "Chest Physical Therapy+")
S7 (MH "Physical Therapy")
S6 S1 or S2 or S3 or S4 or S5
S5 TI (respiratory syncytial virus* or rsv) or AB (respiratory syncytial virus* or rsv)
S4 (MH "Respiratory Syncytial Virus Infections")
S3 (MH "Respiratory Syncytial Viruses")
S2 TI bronchiolit* or AB bronchiolit*
S1 (MH "Bronchiolitis+")

Appendix 5. LILACS (BIREME) search strategy

(MH:bronchiolitis OR MH:C08.127.446.135$ OR MH:C08.381.495.146.135$ OR MH:C08.730.099.135$ OR bronchiolit$ OR Bronquiolitis OR Bronquiolite OR MH:"Respiratory syncytial viruses" OR "respiratory syncytial virus" OR "respiratory syncytial viruses" OR "Virus Sincitiales

Respiratorios" OR MH:"respiratory syncytial virus infections" OR "Infecciones por Virus Sincitial Respiratorio" OR rsv OR "Infecciones por Virus Sincitial Respiratorio" OR "Infecções por Vírus Respiratório Sincicial") AND (MH:"physical therapy modalities" OR MH:E02.779$ OR "physical therapy" OR "physical therapies" OR "Modalidades de Terapia Física" OR "Modalidades de Fisioterapia" OR physiotherap$ OR Fisioterap$ OR Fisioterápicas OR "Terapia Física" OR MH:"Drainage, Postural" OR "postural drainage" OR "Drenaje Postural" OR "Drenagem Postural" OR MH:Percussion OR Percusión OR Percussão OR percus$ OR MH:vibration OR vibrat$ OR Vibración OR Vibração OR shak$ OR "directed coughing" OR "directed cough" OR "forced exhalation" OR "forced expiration" OR expiración OR Expiração OR MH:"Breathing exercises" OR "breathing exercise" OR "breathing exercises" OR "Ejercicios Respiratorios" OR "Exercícios Respiratórios")

Appendix 6. Web of Science (Thomson Reuters) search strategy

Topic=(bronchiolit* or rsv or respiratory syncytial virus*) AND Topic=(chest physical therap* or chest physiotherap* or postural drainage or chest percussion or chest vibration or chest shaking or directed coughing or forced exhalation or breathing exercises)
Timespan=2006-2009. Databases=SCI-EXPANDED, CPCI-S.

Appendix 7. Details of previous searches

In the first version of this review we searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2004, Issue 2), which contains the Cochrane Acute Respiratory Infections Group's Specialised Register; MEDLINE (January 1966 to June 2004); EMBASE (1990 to June 2004); PASCAL, SCISEARCH, LILACS and Cumulative Index to the Nursing & Allied Health Literature (CINAHL) (1982 to May 2004).

In June 2006 we updated the searches of CENTRAL (*The Cochrane Library* 2006, Issue 2); MEDLINE (2004 to May Week 4 2006); EMBASE (July 2004 to December 2005) and CINAHL (1982 to May Week 4 2006).

In 2011 we searched the Cochrane Central Register of Controlled Trials (CENTRAL) 2011, Issue 4, part of *The Cochrane Library*www.thecochranelibrary.com (accessed 13 December 2011), which includes the Cochrane Acute Respiratory Infections Group's Specialised Register, MEDLINE (May 2006 to November week 3, 2011), MEDLINE in-process and other non-indexed citations (8 December 2011), EMBASE.com (December 2005 to December 2011), CINAHL (2006 to December 2011), LILACS (2006 to December 2011) and Web of Science (2006 to December 2011).

In 2015 we conducted a top-up search. We searched the Cochrane Central Register of Controlled Trials (CENTRAL 2015, Issue 6) (accessed 8 July 2015), the Cochrane Acute Respiratory Infections Group's Specialised Register (October 2011 to July 2015), MEDLINE and MEDLINE in-process and other non-indexed citations (October 2011 to July 2015), EMBASE (October 2011 to July 2015), CINAHL (October 2011 to July 2015), LILACS (October 2011 to July 2015), Web of Science (October 2011 to July 2015) and Pedro (October 2011 to July 2015).

We used the following search strategy to search MEDLINE and CENTRAL in June 2006. The highly sensitive search strategy filter (Dickersin 1994) was combined with the search strategy and run over MEDLINE. The MEDLINE search was modified slightly to search CINAHL. No language restrictions were applied.

MEDLINE (OVID)
1 exp BRONCHIOLITIS
2 exp Bronchiolitis, Viral/
3 bronchiolitis.mp.
4 exp Respiratory Syncytial Viruses/
5 exp Respiratory Syncytial Virus Infections/
6 respiratory syncytial virus$.mp.
7 exp Physical Therapy Techniques/
8 chest physiotherapy.mp.
9 exp Drainage, Postural/
10 postural drainage.mp.
11 chest percussion.mp.
12 exp VIBRATION/
13 vibration.mp.
14 chest shaking.mp.
15 directed coughing.mp.
16 forced exhalation.mp.
17 exp Breathing Exercises/
18 breathing exercise$.mp.
19 or/1-6
20 or/7-18
21 19 and 20

EMBASE (WebSpirs)
#1 explode 'bronchiolitis-' / all subheadings in DEM,DER,DRM,DRR

#2 (bronchiolitis in ti) or (bronchiolitis in ab)
#3 explode 'Respiratory-syncytial-pneumovirus' / all subheadings in DEM,DER,DRM,DRR
#4 (respiratory syncytial virus* or RSV) in ti
#5 #1 or #2 or #3 or #4
#6 explode 'physiotherapy-' / all subheadings in DEM,DER,DRM,DRR
#7 (physiotherapy in ti) or (physiotherapy in ab)
#8 explode 'postural-drainage' / all subheadings in DEM,DER,DRM,DRR
#9 (postural drainage in ti) or (postural drainage in ab)
#10 (chest percussion in ti) or (chest percussion in ab)
#11 explode 'vibration-' / all subheadings in DEM,DER,DRM,DRR
#12 (vibration in ti) or (vibration in ab)
#13 (chest shaking in ti) or (chest shaking in ab)
#14 (directed coughing in ti) or (directed coughing in ab)
#15 (forced exhalation in ti) or (forced exhalation in ab)
#16 explode 'breathing-exercise' / all subheadings in DEM,DER,DRM,DRR
#17 (breathing exercise* in ti) or (breathing exercise* in ab)
#18 #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17
#19 #5 and #18

F E E D B A C K

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old, 5 March 2012

Summary

We have read with much interest the last Cochrane review devoted to Chest Physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months. (1) M. Roqué and her co-authors have reported the most recent publications in this field.

We would like to present some remarks:

1. The study of Postiaux et al. has been performed in Belgium, and not in France as mentioned in the Cochrane publication. (2) Even if this aspect is not scientifically relevant, it implies different methodological PT approaches.
2. M. Roqué et al. have merged two different PT approaches in a same appellation “forced expiration techniques”, adding to the confusion concerning the PT techniques. Indeed, their different functional features are essential. The first one is the Increased Exhalation Technique - IET (augmentation/accélération du flux expiratoire) mainly used in France (see the Gajdos and Sanchez studies (3, 4)), which is a passive forced (i.e. rapid, robust) expiration technique - FET, and the second one is the Prolonged Slow (i.e. progressive) Expiration technique – PSE (prlonge slow expiration technique) proposed by our group in 1992 to avoid the mechanical drawbacks of the IET - (Increased Exhalation Technique) such as the tracheal collapse. (5) PSE is more attuned to the infant’s specific ventilatory mechanics. (6)
3. It is important to stress that the therapeutic regimens are different. In the Postiaux’ study, PT is preceded by a hypertonic saline solution nebulization NaCL3% – HS3%, while it is not in the other studies. HS3% dilutes the bronchial secretions and helps the mucociliary transport. (7) Both, HS3% and PSE act in synergy.
4. The Cochrane Review states that in the Postiaux’ study, the effect of the treatment “disappeared two hours later”. However the study has shown that the effect of the treatment lasted at least two hours and that a significant day-to-day cumulative effect had been observed. These results envision a long term effect of such a treatment.
5. Explaining the apparent controversial results are also the different levels of severity of the patients samples. The Gajdos’, Sanchez’ and Rochat’ (8) studies were dealing with severe bronchiolitis while the Postiaux’ study dealt with moderate bronchiolitis. Severe bronchiolitis are known to be poorly tolerating any handling procedure, probably explaining the lack ok positive outcome of IET in this group.

We think that those elements are likely to clarify the PT methods and better define the indications/contraindications of PT in RSVB.

1. Roqué I Figuls M, Giné-garriga M, Granados Rugeles C, Perrotta C. Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. Cochrane database of Systematic Review 2012 Issue 2.Art No.:CD004873, DOI:10.1002/14651858.CD004873.pub4.
2. Postiaux G, Louis J, Labasse HC, Patte C, Gerroldt J, Kotik AC, Lemuhot A. Effects of an alternative chest physiotherapy regimen protocol in infants with RSB bronchiolitis. Resp Care 2011;56,7:989-94.
3. Gajdos V, Katsahian S, Beydon N, et al. Effectiveness of Chest Physiotherapy in Infants Hospitalized with Acute Bronchiolitis : A Multicenter, randomized, Controlled Trial. PLoS Med 2010;7(9) : e1000345.doi:10.1371/journal.pmed.1000345.
4. Sánchez Bayle M, et al. Estudio de la eficacia y utilidad de la fisioterapia respiratoria en la bronquiolitis aguda del lactante hospitalizado. Ensayo clínico aleatorizado y doble ciego. An Pediatr (Barc). 2012. doi:10.1016/j.anpedi.2011.11.026 5. Postiaux G., Lens E. De ladite Accélération du Flux Expiratoire…où forced is fast

Submitter agrees with default conflict of interest statement: I certify that I have no affiliations with or involvement in any organization or entity with a financial interest in the subject matter of my feedback.

Reply

Dear Dr Postiaux, thank you for your comments that allow us to improve our work. In response to your feedback, we would like to formulate the following remarks:

1. We apologise for the confusion regarding countries, and we have amended the review accordingly.
2. Throughout the text we have tried to clarify the differences between these techniques, grouped now as passive expiratory techniques instead of forced expiratory techniques. Efficacy and safety results for both techniques have been clearly labelled in the results and discussion sections.
3. We have clarified this point in the discussion and conclusions sections.
4. We have added a quote in the results section mentioning the day-to-day cumulative effect. Nevertheless, we've considered that this result is inconclusive and doesn't change the overall results and conclusions of the review. The reasons are that this apparent cumulative effect is based on 1) within group comparisons and not between group comparisons, and 2) assessment of a reduced number of patients due to discharges during follow-up.
5. We have added specific mentions to the severity of patients.

After careful consideration of this feedback we have introduced several changes in the review with the aim to clarify the differences between the diverse passive expiratory techniques, and to highlight their respective efficacy and safety results. This greater detail has lead to amend the implications for research section, given that the prolonged slow expiration technique appears to be safe and that it may be related to (at least) a transient effect. Nevertheless, the overall conclusion of the review and its implications for practice have not changed.

Contributors

Guy Postiaux. Occupation: An author cited in the Review
Jacques Louis.

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old, 29 April 2016

Summary

I noticed the values of relative risk etc related to ‘vomiting during procedure’ or ‘respiratory destabilisation’ published in the Cochrane review (from the Gajdos 2010 paper) have been incorrectly reversed – this is important in terms of readers understanding the actual consequences of treatment... The mistake is consistent throughout the text of the Cochrane review.

Reply

Thanks for pointing out this transcription error. The text and tables have been modified to show the correct risk values for respiratory destabilisation (RR 5.4, 95% CI 1.6 to 18.4, P = 0.002) and vomiting during the procedure (RR 10.2, 95% CI 1.3 to 78.8, P = 0.005). These values had been interchanged during transcription.

Contributors

Professor Eleanor Main FCSP (BSc, BA, MSc, PhD) Programme Director: UCL MSc, Diploma & Certificate in Physiotherapy

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old, 4 May 2017

Summary

In the Cochrane review “Chest physiotherapy for acute bronchiolitis in pediatric patients between 0 and 24 months old (Review)”, published on Cochrane Database of Systematic Reviews 2016, Issue 2. Art. No.: CD004873. DOI: 10.1002/14651858.CD004873.pub5., you analyse, among other studies, one study from our authorship (Remondini R, Santos AZ, Castro G, Prado C, Silva Filho LV. Comparative analysis of the effects of two chest physical therapy interventions in patients with bronchiolitis during hospitalization period. Einstein. 2014;12(4):452-8).

After a thoughtful review of your review, we identified some conclusions reached by you that do not fit with our study.

Under “Summary of findings for the main comparison”: In our study, we didn't compare expiratory acceleration flow with no-physiotherapy for acute bronchiolitis, but the comparison was made between expiratory acceleration flow and conventional physiotherapy (manual percussion or tapping).

Under “Results – Included studies”: It classifies the study as forced expiration techniques, but the study compares expiratory acceleration flow and conventional techniques (manual percussion or tapping).

Under “Passive expiratory techniques - forced passive expiratory techniques - Primary outcomes - Change in the severity status of bronchiolitis”: It mentions that “They observed significant differences immediately after forced passive expiratory physiotherapy + postural

drainage (10 and 60 minutes post intervention; P <0.001). However, when compared to conventional physiotherapy (postural drainage), no differences were found", nevertheless the conventional physiotherapy is defined as postural drainage + manual percussion or tapping, not postural drainage only.

Under "Results – Postural drainage percussion and vibration techniques – Primary outcomes 1 – Change in the severity status of bronchiolitis": Our study should be cited as "One trial (29 participants) compared the addition tapping to postural drainage. The trial assessed severity of bronchiolitis using respiratory distress assessment instrument (RDAI) (Remondini 2014). They observed significant differences immediately after conventional physiotherapy (tapping + postural drainage (10 and 60 minutes post intervention; P<0.001), the same result was observed after forced passive expiratory physiotherapy + postural drainage)".

Under "Parents' impression of physiotherapy benefit": it was mentioned "No trial presented data on parents' impression of physiotherapy benefit except Gajdos", however our study presented that parents answered positively about the effects of therapy in the majority of items in the questionnaire about the treatment applied, both for the expiratory acceleration flow technique and for tapping.

In summary, in our study we compare the effects of two chest physiotherapy interventions in patients hospitalised due to acute bronchiolitis, with randomised patients and two groups (Group 1, submitted to postural drainage, tapping and tracheal aspiration; and Group 2, submitted to postural drainage, expiratory acceleration flow and tracheal aspiration). We never compared Forced Passive Expiratory Physiotherapy with just postural drainage.

A relevant improvement was observed on the Respiratory Distress Assessment Instrument score with physical therapy, with reduction of the score 10 minutes after interventions, and the same score 60 minutes later, with no differences between techniques applied. No differences were observed between groups regarding the items assessed (time required to discharge from study, pulse oximetry in room air and disease severity according to the Respiratory Distress Assessment Instrument score).

We are available for any clarification.
Best Regards,
Renata Remondini PT (on behalf of the authors)

Reply

Under "Summary of findings for the main comparison" we changed the term "no-physiotherapy" to "standard care" and deleted "(excluding chest physiotherapy)".

Under "Results – Included studies": Remondini et al used the conventional terminology used by Gajdos 2010 for describing a type of technique commonly used in France. The "expiratory acceleration flow" AFE in France, is related to a manual chest compression during the expiratory phase that produces a high increase of flow in order to help mucus expectoration. This type of manoeuvre is globally called, force expiration technique.
We changed the name in the review as suggested by Remondini in order to better fit with their original work but kept it in the same classification group.
These changes also are made to the Table Remondini 2014 - Interventions.

Under "Passive expiratory techniques - forced passive expiratory techniques - Primary outcomes - Change in the severity status of bronchiolitis": we agree with the feedback and followed their suggestion.

Under Results – Postural drainage percussion and vibration techniques – Primary outcomes 1 – Change in the severity status of bronchiolitis: again we agreed with the feedback

Under "Parents' impression of physiotherapy benefit": we agree with the feedback. Firstly, we changed in "Postural drainage plus percussion and vibration techniques - Secondary Outcomes", outcome 5. Parents' impression of physiotherapy benefit "No trial presented data on parents' impression of physiotherapy benefit in this comparison. except Gajdos (Gajdos 2010). In it, they did not observe any significant difference in the way the parents rated the influence of physiotherapy on respiratory status (risk ratio (RR) 0.99, 95% CI 0.90 to 1.08, P = 0.89) or comfort (RR 0.99, 95% CI 0.94 to 1.05, P = 0.84).
Secondly, we changed in "Passive expiratory techniques – forced passive expiratory techniques - Secondary outcomes", Outcome 5. Parents' impression of physiotherapy benefitTwo trials provided data on the parents' impression on the benefit of chest physiotherapy.

Remondini 2014 presented data on the parents' impression on the benefit of physiotherapy compared to conventional physiotherapy postural drainage alone. Parents' in both groups reported satisfaction related to improvements of breathing, feeding and nasal congestion, but, no difference was observed between the intervention groups. Gajdos 2010 reported they did not observe any significant difference in the way the parents rated the influence of physiotherapy on respiratory status (risk ratio (RR) 0.99, 95% CI 0.90 to 1.08, P = 0.89) or comfort (RR 0.99, 95% CI 0.94 to 1.05, P = 0.84).

We did not compare forced passive expiratory physiotherapy with just postural drainage.

Contributors

Jordi Vilaró and Marta Roqué i Figuls

WHAT'S NEW

Date	Event	Description
3 April 2023	New search has been performed	We included five new trials in this update (Conesa-Segura 2018; Gomes 2016; González-Bellido 2020; Ramos-Pinto 2021; Van Ginderdeuren 2017), and excluded three new trials (Sebban 2017; Sebban 2019; Evenou 2017). We identified five ongoing studies (NCT02708147; NCT02853838; NCT03738501; NCT03753802; NCT04553822).
3 April 2023	New citation required and conclusions have changed	Positive effects were observed for slow expiratory techniques. The meta-analysis of the effects of slow expiratory technique on clinical severity score showed mild but significant effects in decreasing the severity of the infant's condition after the intervention. These positive effects were increased when slow expiratory technique was combined with rhinopharyngeal retrograde technique.

HISTORY

Protocol first published: Issue 3, 2004
Review first published: Issue 2, 2005

Date	Event	Description
29 June 2017	Feedback has been incorporated	Feedback comment and response from authors added to the review.
10 October 2016	Amended	Acknowledgement statement edited.
19 May 2016	Amended	Data transcription error corrected in Abstract.
19 May 2016	Feedback has been incorporated	Data transcription error reported and corrected.
4 May 2016	Feedback has been incorporated	Reader feedback and authors' responses and corrections incorporated.
8 July 2015	New search has been performed	Searches updated. We included three new trials (Gomes 2012; Remondini 2014; Sanchez Bayle 2012), and excluded one new trial (Castro 2014). We identified one ongoing trial (ACTR12608000601336).
8 July 2015	New citation required and conclusions have changed	Review amended to add a finer classification of interventions and to introduce the analysis of severity of disease. Dr Jordi Vilaró joined the review team to update this review. New evidence is presented for slow passive expiratory techniques. The role of respiratory syncytial virus (RSV) and severity of disease are discussed as potential modifiers of the effect of chest physiotherapy.

Date	Event	Description
9 November 2012	Feedback has been incorporated	Reply to feedback comment added to the review.
3 July 2012	Feedback has been incorporated	Feedback comment added to the review.
13 December 2011	New search has been performed	Searches conducted. Six new trials were included in this update (Aviram 1992; De Córdoba 2008; Gajdos 2010; Lopez Galbany 2004; Postiaux 2011; Rochat 2010), and one trial was excluded (Pupin 2009).
13 December 2011	New citation required and conclusions have changed	New evidence shows no benefit of forced expiratory techniques. A new review author joined the original author team to update the review.
14 May 2008	Amended	Converted to new review format
19 July 2006	New search has been performed	Updated review Issue 1, 2007
9 June 2004	New search has been performed	First published Issue 2, 2005

CONTRIBUTIONS OF AUTHORS

Marta Roqué was responsible for updating the review.
Marta Roqué, Maria Giné, and Jordi Vilaró performed the risk of bias assessment and data extraction, interpretation of results, and drafting of the updated review text.
Carla Perrotta and Claudia Granados conducted reference screening.
All authors commented on the interpretation of results and the text of the review, and contributed to the final version of the review.

DECLARATIONS OF INTEREST

Marta Roqué i Figuls: declares that they have no conflict of interest.
Maria Giné-Garriga: declares that they have no conflict of interest.
Claudia Granados Rugeles: declares that they have no conflict of interest.
Carla Perrotta: declares that they have no conflict of interest.
Jordi Vilaró: declares that they have no conflict of interest.

SOURCES OF SUPPORT

Internal sources

- No source of support, Spain

  No sources of support were obtained.

External sources

- No source of support, Spain

  No sources of support were obtained.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

2022 update

In the current update, we reorganised the reporting of results, presenting first the interventions where research is currently more active, and then the interventions used in practice progressively less (vibration and percussion). We added a new subgroup analysis to the slow expiratory comparison, to show results separately for those studies using physiotherapy techniques with and without rhinopharyngeal retrograde technique. We added two new interventions in the current update: instrumental techniques and rhinopharyngeal retrograde technique. Finally, we conducted a meta-analysis for slow expiratory techniques comparing their effects on clinical severity score.

We added one outcome specifically for ambulatory patients, related to avoidance of hospital admission or emergency visits.

2016 update

In the 2016 update, we classified the trials by type of physiotherapy technique into vibration and percussion techniques and passive expiratory techniques. We further subdivided the latter subgroup into slow passive expiratory techniques and forced passive expiratory techniques. We changed respiratory parameters, which were previously primary outcomes, to secondary outcomes in the 2016 update. We added subgroup analyses by disease severity of participants and setting, after feedback received on previous versions made it clear that the review included trials of participants with wide-ranging severity, and there was a plausible hypothesis that the efficacy of the interventions varied with severity and setting (a covariate highly correlated with severity of participants). We added summary of findings tables for the comparisons of 'forced expiration versus standard care for acute bronchitis' and 'slow passive expiration versus standard care for acute bronchitis'. To better reflect the secondary objective of determining the efficacy of different techniques of chest physiotherapy (e.g. vibration and percussion and passive forced exhalation), we modified the 'Types of interventions' section to explicitly allow inclusion of studies with active comparators.

INDEX TERMS

Medical Subject Headings (MeSH)

*Bronchiolitis [drug therapy]; Bronchodilator Agents [therapeutic use]; Drainage, Postural; Oxygen; Physical Therapy Modalities; *Respiratory Therapy [methods]

MeSH check words

Child; Child, Preschool; Humans; Infant; Infant, Newborn