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ORIGINAL RESEARCH

Impact of physical therapy on different types of bronchiolitis, patients, and care settings: A systematic review

Impacto da fisioterapia nos diferentes tipos de bronquiolite, pacientes e locais de atendimento: revisão sistemática

Impacto de la fisioterapia sobre diferentes tipos de bronquiolitis, pacientes y locales de atención: una revisión sistemática

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ABSTRACT | Bronchiolitis is defined as an acute episode of wheezing that occurs in the context of a respiratory condition, usually of viral origin, with a high incidence in children under 2 years of age. Considering that the role of physical therapy has been questioned in this context, it is paramount to clarify and differentiate the impact of different physical therapy techniques employed for each type of bronchiolitis, patient, and care settings. A systematic review was performed, searching the Science Direct, MEDLINE/PubMed, and SciELO databases on physical therapy techniques in children up to 2 years of age with a bronchiolitis episode. Six observational studies, 5 experimental studies without control group and 15 with control group, involving 3339 individuals were included. Fourteen studies use inpatient samples, six analyze hospital and ICU samples, and six studied outpatient samples. Among the most commonly used respiratory physical therapy techniques are the prolonged slow expiration (PSE) associated with provoked coughing (PC), expiratory flow increase (EFI), retrograde rhinopharyngeal clearance (RRC) and postural drainage (PD). Positive results were found regarding respiratory physical therapy techniques, namely RRC, PSE and EFI or PC, on airway permeabilization, promotion of bronchial hygiene, hospital stay, oxygen saturation, clinical score, heart rate, respiratory rate, and need for oxygen therapy. As limitations of the study, it is highlighted the lack of studies with robust and comparable methodologies to draw conclusions with greater certainty, especially regarding different severities of the pathology, thus supporting the personalization and adequacy of interventions in clinical practice.

Keywords | Physical Therapy; Bronchiolitis; Infant.

RESUMO | A bronquiolite é definida como um episódio agudo de sibilâncias que ocorre no contexto de um quadro respiratório, de origem normalmente viral, com elevada incidência nas crianças com menos de 2 anos. Considerando que o papel da Fisioterapia tem sido questionado nesse contexto, é extremamente importante esclarecer e diferenciar o impacto das diversas técnicas de fisioterapia empregadas em cada tipo de bronquiolite, paciente e local de atendimento. Foi realizada uma revisão sistemática, com busca nas bases de dados ScienceDirect, MEDLINE/PubMed e SciELO, sobre as técnicas de fisioterapia em crianças de até 2 anos de idade com episódio de bronquiolite. Foram incluídos seis estudos observacionais, cinco experimentais sem grupo de controle e 15 com grupo de controle, envolvendo 3.339 indivíduos. São 14 os estudos com amostras em internamento, seis em internamento e unidade de cuidados intensivos (UCI) e seis em ambulatório. Dentre as técnicas de fisioterapia respiratória mais utilizadas, destacam-se a técnica de expiração lenta e prolongada (ELPr) associada à tosse provocada (TP), a aumento do fluxo expiratório (AFE), a desobstrução rinofaríngea retrógrada (DRR) e a drenagem postural (DP). Encontraram-se resultados positivos em relação às técnicas de fisioterapia respiratória, nomeadamente DRR,

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ELPr e AFE ou TP, na permeabilização das vias aéreas, promoção da higiene brônquica, dias de hospitalização, saturação de oxigênio, pontuação clínica, frequência cardíaca, frequência respiratória e necessidade de oxigenoterapia. Como limitações do estudo, destaca-se o fato de não haver estudos suficientes com metodologias robustas e comparáveis que permitam chegar a conclusões com maior certeza, em especial em relação às diferentes severidades da patologia, e fundamentar assim a personalização e adequação das intervenções na prática clínica.
Descritores | Fisioterapia; Bronquiolite; Lactente.

RESUMEN | La bronquiolitis se define como un episodio agudo de sibilancia que resulta de una infección respiratoria, generalmente viral, con alta incidencia en niños con menos de 2 años de edad. Teniendo en cuenta que el papel de la Fisioterapia ha sido cuestionado en este contexto, es de suma importancia aclarar y diferenciar el impacto de las diferentes técnicas de fisioterapia utilizadas en cada tipo de bronquiolitis, paciente y lugar de atención. Se realizó una revisión sistemática, buscando en las bases de datos ScienceDirect, MEDLINE/PubMed y SciELO técnicas de fisioterapia en niños de hasta 2 años con un episodio de bronquiolitis. Se incluyeron seis estudios observacionales, cinco estudios experimentales sin grupo de control, y 15 con grupo de control, involucrando a 3.339 individuos. Son 14 estudios con muestras de pacientes hospitalizados, seis con pacientes hospitalizados y en unidades de cuidados intensivos (UCI), y seis con pacientes ambulatorios. Entre las técnicas de fisioterapia respiratoria más utilizadas destacan la técnica de espiración lenta y prolongada (ELPr) asociada a tos provocada (PT), flujo espiratorio aumentado (AFE), drenaje rinofaríngeo retrógrado (DRR) y drenaje postural (DP). Se encontraron resultados positivos con relación a las técnicas de fisioterapia respiratoria, como el DRR, ELPr y AFE o PT, en la permeabilización de las vías aéreas, promoción de la higiene bronquial, días de hospitalización, saturación de oxígeno, puntaje clínico, frecuencia cardíaca, frecuencia respiratoria y necesidad de oxigenoterapia. Las limitaciones de este estudio fueron los escasos estudios con metodologías robustas y comparables que permitan llegar a conclusiones más seguras, especialmente con relación a las diferentes severidades de la patología, y así apoyar la personalización y adecuación de las intervenciones en la práctica clínica.
Palabras clave | Fisioterapia; Bronquiolitis; Lactante.

INTRODUCTION

Bronchiolitis is defined as an acute episode of wheezing that occurs in the context of a respiratory condition, usually of viral origin, mainly affecting infants[1]. It is estimated that the disease affects 30% of infants, who have at least one episode in their lifetime. Approximately 1 to 3% of respiratory syncytial virus (RSV) infections in children are associated with high morbidity and mortality[1,2]. The physical therapy approach differs substantially from the practices used in adults, and it must respect the patient's age and relative anatomical and physiological factors[3]. The techniques are used to permeabilize the airways, promote comfort, and aid function recovery[4]. Interventions include combinations of very different techniques[5], which are divided into two main approaches: one comprises percussion and postural drainage techniques, while the other acts by changing ventilatory flows[6]. The role of such techniques is still controversial and their recommendation, challenging[6,7]. Clinically, we commonly observe that children in severe or mild conditions do not benefit from the application of respiratory physiotherapy techniques, unlike those in moderate conditions[7]. We should note that while most studies are carried out with inpatients, most patients are never hospitalized[8,9]. Therefore, this review sought to clarify the impact of physical therapy on different types of bronchiolitis, patients, and care settings.

METHODOLOGY

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and criteria[10] and is registered in the International Prospective Register of Systematic Reviews (PROSPERO) under number CDR42021239709.

The search was carried out in the ScienceDirect, MEDLINE/PubMed, and SciELO databases, using the terms obtained via the PICO[11] questionnaire: *Population: bronchiolitis, infants; Intervention: physical therapy; Comparison: severity, acute, chronic, home, outpatient and inpatient care; Outcome: (all) and their translation to Portuguese*. Inclusion criteria consisted of observational or experimental studies on infants, bronchiolitis, and physical therapy intervention. Studies that addressed pathologies or conditions that affect the respiratory system were excluded.

Quality of the articles was assessed using the National Heart, Lung, and Blood Institute (NHLBI)[12] instruments: Quality Assessment of Controlled

Intervention Studies, for controlled experimental studies, and Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, for observational studies (cohort and cross-sectional), both with 14 questions; and Quality Assessment Tool for Before-After (Pre-Post) Studies With No Control Group, for experimental studies without control group, with 12 questions, resulting in the classification of studies as good, sufficient, or poor. Description of the article selection was made using the PRISMA[10] flowchart, and the review evaluation was performed using the PRISMA checklist (Appendix I)[10].

After search and article selection, two independent investigators assessed the methodological quality of each study. Results were presented in table form for each of the articles and a descriptive and exploratory analysis of such articles was carried out together. Finally, agreement analysis of the quality assessment of the articles was performed using the Kappa coefficient (0.05 significance level). Data and articles underwent exploratory and descriptive analysis.

RESULTS

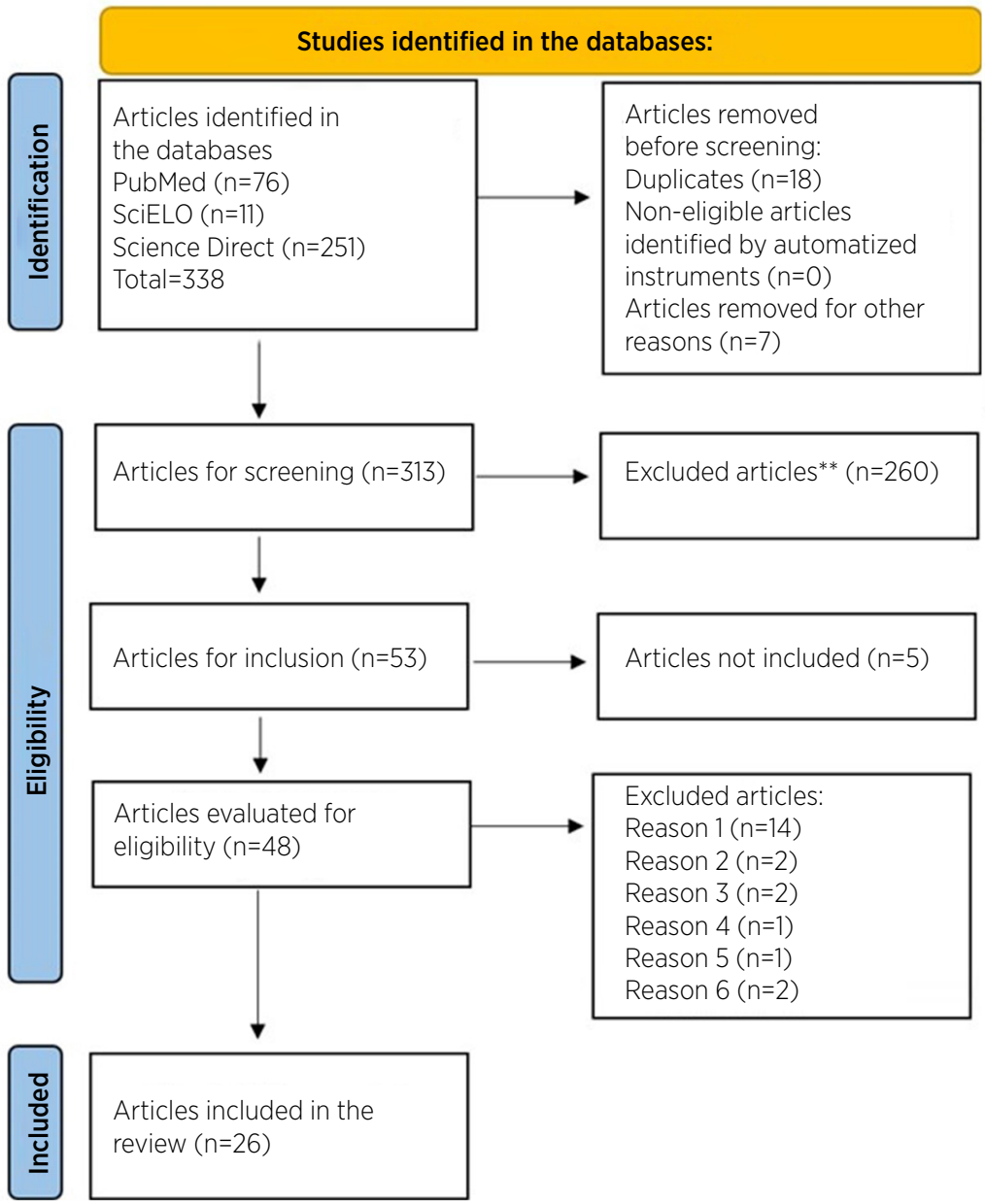

Figure 1. – PRISMA flowchart
Source: Page et al.[10].
Reason 1: physiotherapy is non-existent, not described or inseparable from other approaches; Reason 2: does not assess clinical or functional picture; Reason 3: sample with other pathologies; Reason 4: outside age range; Reason 5: not an article; Reason 6: article not accessible.

From the database searches carried out in May 2021, we obtained 338 articles. After screening and careful analysis of study eligibility, the review included 26 articles (Figure 1), comprising a total of 3,339 individuals. Their methodological quality tended towards good (Appendix II), and the agreement between evaluators was almost perfect, at 80.77% (kappa=0.71, p=0.05). The studies (6 observational, 5 experimental without control group and 15 experimental with control group) were published between 1985 and 2020, comprising 14 with inpatient samples, six with inpatient and intensive care unit (ICU) samples, and six with outpatient samples. Table 1 summarizes the most relevant information for each article (author and year, sample, objective, procedures, evaluation methodology and results). Regarding physical therapy techniques, the results often did not reach a consensus. Prolonged slow expiration (PSE) reduced hospitalization days when associated with provoked cough (PC) and forced inspiration[13], but not when associated with PC alone[14]. When associated with PC, the technique reduces the degree of severity, with normalization of respiratory rate (RR) and oxygen saturation (SpO_2)[15-17]. A study on PSE application with PC, however, found no significant changes in Wang's clinical severity score, nor in SpO_2[17]. Increase in expiratory flow (EF) showed significant changes in SpO_2[18] and in the severity score[19], with reduction of adventitious sounds, and retractions when associated with vibration and nasotracheal aspiration[8].

Table 1. Articles' presentation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Bailleux, 2011	RCT	AB Hospitalization n=496 (238<2 months+258≥2 months) 289 positive RSV 216 cases of hypoxemia	CG: Nasal aspiration EG: EFI+PC	Average recovery time (days)	CG Total population: 2.31 (1.99-2.73) <2 months: 2.64 (2.25-3.08) • 2 months: 2.01 (1.65-2.44) VHR+2.34 (1.99-2.99) Hypoxemia: 2.73 (2.31-3.33) EG Total population: 2.02 (1.98-2.40) <2 months: 2.47 (1.98-3.31) • 2 months: 2.00 (1.51-2.25) VHR+2.33 (1.96-2.92) Hypoxemia: 2.47 (2.02-3.22)
Barbié, 2008	RCT	Severe AVB Outpatient clinic 12 babies (7 ♂ + 5 ♀) Age from 29 days to 15 months (average 5.4 months) GAN: 7 children GDRR: 5 children	GAN: Nasopharyngeal Aspiration GDRR: RRC	Silverman's score (breathing difficulty): 3 or 4 (moderate), 5 or 6 (intense) and 7 or 8 (very intense) SpO_2 (%) Reassessment of the clinical picture after the technique (T0) and 5 min later (T5)	Silverman's score: GAN: T0<T1 (p=0.029) GDRR: T0=T1 GAN>GDRR (p=0.002)
Bernard-Narbonne, 2003	Clinical trial without control group	AB Hospitalization 57 infants hospitalized in the resuscitation service, ventilated.	EFI Duration: 5-10 min depending on the infant's tolerance	SpO_2 (%) Transcutaneous capnia (TcPCO2)(mmHg) Inspiratory tidal volume (VTI)(ml) Expiratory tidal volume (VTE)(ml) T0: before tracheal aspiration T1: after tracheal aspiration T2: after 1 RR session + tracheal aspiration T3: 1 hour after RR	SpO_2 T0: 94.5±3.8; T1: 95.5±9.9 T2: 98±5.3 (p<0.05) T3: 97.5±10.5(p<0.05) VTI T0: 55.4±16 T1: 59.6±17 T2: 66.3±19(p<0.05) T3: 63.6±20(p<0.05) VTE: T0: 53.15±16 T1: 59.1±17 T2: 66.1±20(p<0.05) T3: 62.3±21(p<0.05)

(continues)

Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Bohe, 2005	RCT	32 patients Hospitalization 21♂ + 11♀ Average age: 84.8 days Average length of stay: 3.9 days 25 with VHS+ CG=16 EG=16	CG: Nasopharyngeal aspirations EG: Same as control group + DP + Percussion + Vibrations	Clinical breathing difficulty score Severity score based on HR, respiratory, auscultation, and use of accessory muscles (0 to 12 points) Length of hospital stay (days) Moments: admission and after discharge	EG Clinical score on admission: 5.56±1.96 after discharge: 3.25±1.27 Average hospital stay: 4.00±2 CG Clinical score on admission: 5.75±1.61 Score after discharge: 3.12±1.15 Average hospital stay: 3.87 ± 1.3 Clinical score at admission (p=0.77) Score after discharge (p=0.76) Average hospital stay (p=0.84)
Carroll, 2016	Retrospective OBS	AVB ICU 184 (57%) ♂ + 139 (43%)♀ Age=68 days Hospitals BCH Age=67 (39-146) days 35 (50%) CCMC Age=60 (34-118) days 56 (54%) ♂ MFCH Age=73 (31-230) days 44 (62%) ♂ YNHCH Age=49 (63%)♂ 88 (36-302) days		Time in the ICU (hours) Hospitalization time (hours) Use of: - Albuterol (76%) - RR - Hypertonic saline solution - High-flow nasal cannula - Non-invasive ventilation - Intrapulmonary percurssive ventilation - Ipratropium - Systemic corticosteroids. - Inhaled corticosteroids	Time in the ICU BCH=48 (28-150) CCMC=104 (51-231) MFCH=52 (27-108) YNHCH=66 (36-105) Hospitalization time BCH=145 (98-239) CCMC=186 (118-358) MFCH=151 (90-205) YNHCH=118 (69-202) Intubated: BCH 20% CCMC 44% MFCH 13% YNHCH 19% Average of all hospitals: Time in the ICU=5.3±8.5 days 76% Albuterol 26% Intubated Variations between hospitals: - Albuterol (p=0.002) - RR (p<0.001) - Hypertonic saline solution (p<0.001) - High-flow nasal cannula (p<0.001) - Non-invasive ventilation (p<0.001) - Intrapulmonary percurssive ventilation (p<0.001) - Ipratropium (p<0.001) - Systemic corticosteroids (p<0.001) - Inhaled corticosteroids (p=0.01) Time in the ICU increased with: Invasive mechanical ventilation (p<0.001) Inhaled corticosteroid (p=0.0006) Intrapulmonary percurssive ventilation (p<0.001) RR (p=0.0005)

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Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Castro, 2011	EXP without CG	AB Hospitalization 29 children 13♂ + 16♀ 4.6±3 months	RR Session: with 10 minutes of each technique: -DP -EFA -Percussion -Vibration -Nasotracheal aspiration	Use of oxygen therapy Adventitious sounds (medium frequency crackles, high frequency crackles, WH, snoring) Retractions: Nasal flutter Intercostal Subdiaphragmatic Sternal SpO2 (%) Downes' Score: Severity: Mild (1-3), Moderate (4-7), Severe (8-14) Moments: Before RR (Pre) 15 to 45 min afterwards (Post)	Adventitious noises 81.4% changed (2.1% worse+13.4% better) (p=0.001) Medium frequency crackles 15.27% changed (14.4% worse+22.8% better) (p=0.017) WH 32.9% changed (12.7% worse+16.5% better) (p=0.010) Retractions: 21.6% changed (8.2% worse+26.8% better) (p=0.001) Downes' score 20% changed (4.1% worse+ 21.6% better) (p=0.001)
Conesa-Segura, 2019	RCT	AVB Hospitalization and ICU CG: 12 (38%) ♀ 2.8 (1.8-5.1) months 20 with O_2 48 (0-90) hours of O_2 ABBS=6 (31 mild, 56 moderate and 13 severe) EG: 19 (49%) ♀ 3.3 (1.8-7.0) months 23 with O_2 24 (0-72) hours of O_2 ABBS=5 (35 mild, 59 moderate and 3 severe)	CG: Hypertonic saline mist Nasopharyngeal aspiration EG: CG + PSE + PC + RRC	ABBS (mild 0-4, moderate 5-0, severe 10-13) with: WH (0-4) Breathing effort (0-3) Ratio Ins/Exp (0-2) HR (0-2) RR (cycles/min) SpO2 (%) Moments: Pre session (PR) 10 minutes post session (PS) 2 hours after session (P2) Medical discharge (AM)	ABBS: CG (PS/PR=−7%) EG (PS/PR=−46%) (p=0.01) CG < EG (p=0.001) CG (P2/PS=−26%) (p=0.001) EG (P2/PS=−108%) (p=0.001) CG<EG (p=0.001) CG (AM/PR=−1552%) (p=0.001) EG (AM/PR=−440%) (p=0.001) CG<EG (p=0.002) Average time for ABBS<2: CG (4.4)>EG (2.6) (p<0.0001) WH, Respiratory Effort and Insp/Exp Ratio: EG (AM-PR)>CG (AM-PR) (p<0.05)
Evenou, 2017	Prospective OBS	AVB Outpatient clinic 1st session: n=163: 89 ♂ + 74 ♀ 0-6 months: 89 6-12 months: 55 >12 months: 19 2nd session: n=160 0-6 months: 87 6-12 months: 54 >12 months: 19	Two daily sessions with EFI	Wang score Moments: Pre and Post sessions	Wang's score (median) 1st session: Pre=5; Post=4 2nd session: Pre=3; Post=2 1st session Pre > 2nd session Post (p <0.0001)

(continues)

Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Gajdos, 2010	RCT	AVB Hospitalization CG: 141 (56,4%) ♂, 2.0 (1.3-4.0) months 39.1±1.65 Pregnancy 69 in a tobacco environment 100 with eczema or atopic 37 in kindergarten 36 used bronchodilators and 34 used corticosteroids before randomization 222 with eating difficulties 3.0 with respiratory symptoms 110 (44.2%) SpO_2 31 with atelectasis, 152 with RSV 37.2 ±0.7°C EG: 134 (54.5%) ♂ 2.1 (1.3-3.8) months 39.1±1.67 Pregnancy 69 in a tobacco environment 97 with eczema or atopic 29 in kindergarten 47 used bronchodilators and 25 used corticosteroids before randomization 207 with eating difficulties 3.0 with respiratory symptoms 18 with atelectasis, 137 with RSV 37.2±0.6°C	Session: 3× a day, 10-15min Oxygen Therapy + Enteral Feeding + Bronchodilators + Corticosteroids CG: nasal suction EG: EFI + TA	Days of hospitalization Adverse effects during the session Effects 30 days later	Adverse effects during the session: Vomiting CG (1) vs EG (10) (p<0.005) Respiratory instability CG (3) vs EG (16) (p<0.002)
Ginderdeuren, 2017	RCT	Mild and moderate bronchiolitis Hospitalization CG-B (Control with Bouncing): 18♀ +13♂; 160±143 days 6.4±2.5 (kg) 23 (74%) with VSR; 20 to O_2 2.0±0.8 coryza symptoms 12±6 time admission and inclusion (hours) 5.3±0.9 Wang GAAD (assisted autogenic drainage): 15♀ +16♂; 121±118 months 6.2±2.4 (kg) 22 (71%) with RSV; 23 to O_2 2.0±0.8 coryza symptoms 14±5 admission and inclusion time (hours) 5.3±1.2 Wang GIPV (intrapulmonary percussive ventilation): 16♀+15♂; 135±132 months 6.6 ± 2.2 (kg) 23 (74%) with RSV; 18 to O_2 2.0±0.8 coryza symptoms 15±6 time admission and inclusion (hours) 5.5±0.9 Wang	20min/day session CG-B: PC every 5min if there is no spontaneous cough + sitting on a pilates ball, with support, without anterior flexion of the spine, promoting vertical detachments of about 4 to 6cm in amplitude + 3 inhalations of 10min/day GAAD: CG-B + PSE GIPV: CG-B + 4 5-min cycles of intrapulmonary ventilation at 100 to 300 cycles/min and with 6 to 10 mbar, applied by a mask	Days of hospitalization Wang's score (0 to 12) SpO_2 (%) RR (ppm) Moments: T0: pre-treatment T20:– 20min after treatment T80: 1 hour after T20	CG-B: Days of hospitalization: 4.5±1.9 Wang: (T0-T20): 0.2±0.3 (T0-T80): 0.5±0.4 GAAD: Days of hospitalization: 3.6±1.4 Wang: (T0-T20): 0.5±0.5 (T0-T80): 0.8±0.6 GIPV: Days of hospitalization: 3.5±1.3 Wang: (T0-T20): 0.7±0.5 (T0-T80): 0.9 ± 0.5 p-value: CG-B – GAAD Days of hospitalization: 0.05 Wang: (T0-T20): 0.04, (T0-T80): 0.03 CG-B – GIPV Days of hospitalization: 0.03 Wang: (T0-T20): <0.01, (T0-T80): <0.01 GAAD – GIPV Wang: (T0-T20): 0.03

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Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Gomes, 2012	RCT	AVB Hospitalization and ICU Age: 4.08±3.12 months G1: 6♀ + 4♂ days: 126.1±125.8 Wang's Score: 7.0 (5.0-11) 5.896±2.473 kg G2: 3♀ +7♂ days: 157.5±99.26 Wang's score: 7.5 (3.0-10) 7.317±1.987 kg G3: 5♀ + 5♂ days: 102.1±56.16 Wang's score: 7.5 (4.0-11) 5.822±1.029 kg	G1: PSE+RRC G2: modified DP + expiratory compression + vibration + percussion G3: upper airway aspiration	Wheezing (WH) Investigate the primary outcome (CS) RR (bpm) Retractions (RE) GenC (general conditions) (min-max) Intra-Friedman Test SpO_2 (%) Moments: G1 and G2: Admission 2 hours, 48 and 72 hours after admission 1 hour before discharge G3: Admission	Pre/Post 2 hours G1: CS 7.0 (5-11)/4.0(2-7) (p<0.05) WH 1.0 (0-3)/0(0-1) (p<0.05) RE 2.0 (2-3)/1.0(0-2) (p<0.05) G2: CS 7.5 (3-10)/5.5(1-7) (p<0.05) 48 hours: G1: CS 5.5 (1-7)/3.0(1-5) (p<0.05) RE 2.0 (2-3)/1.0(0-2) (p<0.05) G2: CS 4.0 (1-7)/2.0(1-6) (p<0.05) RE 2.0 (2-3)/1.0(0-2) (p<0.05) 72 hours: G1: CS 2.0 (0-6)/1.0(0-4) (p<0.05)
Gomes, 2016	RCT	AVB Hospitalization and ICU GA (aspiration): 48.4♂, 4.78±2.98 months Weight: 6.89±2.03 kg 0.33±1.34 percentile Birth weight: 3.20±0.57 kg First episode: 68% SpO_2: 95.3±3.7% RR 51.7±11.3 cycles/min DG (clearance): 51.6♂, 4.80±2.92 months Weight: 6.70±1.87 kg Percentile 0.08±1.27(Birth weight: 3.21±0.63 kg First episode: 72.0% RR: 51.6±11.0 cycles/min	1 session Saline solution at 0.9% GA: nasal aspiration GD: RRC	Evaluation HR (ppm) RR (bpm) SpO_2 (%) Adverse effects Signs and respiratory distress Clinical severity score (HR, RR, chest retractions, presence of wheezing, cyanosis and auscultation) Moments: Pre: 10 and 30 min after M1: early morning M2: early afternoon M3: night	No significant differences between groups pre session HR: M1: GD<GA at 10 min (p=0.002) and at 30 min (p=0.02) M2: GD<GA at 10 min (p=0.038) and at 30 min (p=0.02) Adverse effects (GA vs GD): nosebleeds: 28 vs 1 vomiting: 11 vs 7 retractions: 100% vs 84.6% Moderate severity score (GA vs GD) retractions (100% vs 84.6%) (p<0.05) nosebleeds (44.8% vs 0%) (p<0.05) High severity score (GA vs GD) nosebleeds (63.6% vs 8.3%) (p<0.05)
Gonçalves, 2014	Cross-sectional OBS	AVB Hospitalization 30 neonates 66.6% ♂ 3.4±1.63 months 3 with antibiotics	Pulmonary re-expansion maneuvers, manual vibration and postural drainage	Evaluation: HR (bpm) SpO_2 (%) RR (ppm) Moments: before treatment (pre) post treatment at 3 (P3), 6 (P6) and 9 (P9) min	RR: Pre (62.1±14) <P3 (66.6±11) (p<0.05) P6 (63.1±11)>P3 (p<0.05) P9 (60.7±12)<P3 (p<0.05) SpO_2 Pre (94.9±1.5) <P3 (95.2±1.3) (p<0.05) P6 (63.1±11)>Pre (p<0.05) P9 (97.3±0.5)>P3 (p<0.05)

(continues)

Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
González-Bellido, 2020	RCT	AVB (light and moderate) Outpatient clinic G1 (airway clearance technique): n=44 17 (38.6%) ♀ 7.5±2.7 months 8.1±1.5 kg 68.9±7.8 cm 95.3±2.3% SpO_2 48.6±8.0 RR G2 (high frequency wall compression): n=47 15 (31.9%) ♀ 8.2±2.4 months 8.2±1.2 kg 69.7±6.6 cm 95.4±2.0% SpO_2 45.5±6.6 RR	1 session only G1: PSE 20min + PC Medication use: 33 Bronchodilator: 38 G2: PSE SmartVest (12Hz frequency and 2-4cm H2O pressure) 15 min Medication use: 39 No: 8 (17.0) Bronchodilator: 2	Evaluation: Wang's score RR (cycles/min) HR (ppm) SpO_2 (%) Mucus (dry volume) (ml) Adverse effects: Petechiae; Tachycardia Vomiting Moments: Pre (admission) After 10 min After 20 min	PRE No significant differences between groups PRE-POST 20 Wang's score G1 and G2: F (2.46.811)=6.09 (p=0.004) GACT (0.14±0.46) vs GHFCWC (0.28±0.54) (n^2=0.007) RR G1 and G2: F (2.46.938)=6.0584 (p=0.004) G1 (27.89±1.93) vs G2 (28.11±2.40) (n^2=0.007) HR G1 and G2: F (2.46.571)=5.943 (p=0.005) G1 (111.0±13.0) vs G2 (116.6±20.0) (n^2=0.006) Mucus: G1(19)>G2(30)(p<0.001) PRE-POST 10-POST 20 Wang's score G1 (54.5 to 9.1%) vs G2 (61.7 to 23.4%) (p=0.009)
Postiaux, 2006	EXP without CG	AVB Hospitalization 19 infants: 10 ♂ + 9 ♀ 7.75±6.6 months 32% history of bronchiolitis 26% history of prematurity 47% positive radiological signs	Daily sessions of 20/30 min (average number of 20 maneuvers applied) Techniques: PSE + PC Positioning: DD, head elevation (35º)	CS: score from 0 to 3 for each variable, with increasing severity receiving an increasingly higher score. SpO_2 (%) HR (ppm) Previous episodes of bronchiolitis (AB) Assessment on the 1st, 2nd and last day of session (57 sessions): before and after 15 min	CS (n=19): Before: 1st day: 4.3±2 2nd day: 3.7±1.8 Last day: 2.1±1.3 After RR: 1st day: 2.1±0.8 2nd day: 1.8±1.1 Last day: 0.9±0.6 (p<0.001) SpO_2 (n=18): Before: 1st day: 96.2±2.2 2nd day: 96.8±2.4 Last day: 97.1±1.4 After RR: 1st day: 97.67±1.57 2nd day: 98.28±1.56 Last day: 98.67±1.27 (p<0.001) HR (n=16): Before RR: 1st day: 149.4±17.4 2nd day: 148.7±17.4 Last day: 145.1±16.4 After RR: 1st day: 142.2±16.4 2nd day: 138.7±14.4 Last day: 134.4±13.1 (p<0.001) Average number of sessions (NS): 3.8±1.7 A daytime effect is observed in CS (p<0.028), and session effect differs in D1 and JD for AB in CS (p=0.020) and SpO_2 (p<0.039).

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Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Postiaux, 2011	RCT	AVB Hospitalization CG (n=8): 4♀ + 4♂ 4.2±3.1 months 6.0±3.2 Wang GNMF (n=12): 2♀ + 10♂ 3.9±2.4 months 5.5 ± 2.9 Wang	CG: 27 sessions 3.3 sessions/patient Nebulization with 3ml albuterol in hypertonic saline solution for 8 to 10 minutes GNMF 31 sessions 2.5 sessions/patient Nebulization followed by 10 to 15 minutes of PSE and PC	Before each session (T0): Wang; SpO_2; HR (T0) Shortness of breath (SoB) After the session: 30min (T30) 120min (T150)	CG: Days of hospitalization: 6.3±2.0 T150 <T0: (4.6 vs 5.0, p=0.008) T150<T0 (1.1 vs 1.2, p=0.02) GCPT: Days of hospitalization: 5.3±1.8 T30: (3.6 vs 4.3, p=0.001) T150: (3.7 vs 4.3, p=0.002) SoB: T30<T0 (0.8 vs 1.3, p=0.001) T150<T0 (0.9 vs 1.3, p=0.001) CG vs GCPT: T30: RR (p=0.001) HR (p<0.001) T30 vs T0: Wang: (p=0.004) SoB: (p=0.001) HR: (p=0.2)
Pupin, 2009	RCT	AVB Outpatient clinic EFI and RRC Group (GAD) 18♂ + 9♀ 4.59±2.75 months 7 comorbidity 6 premature 13 oxygen support DP Group (GDP) 15♂ + 12♀ 4.19±2.22 months 5 comorbidity 8 premature 10 oxygen support Control group (CG) 15♂ + 11♀ 4.78±2.98 meses 7 comorbidity 4 premature 15 with oxygen support	Positioning: bench press with headboard elevation GAD: EFI + RRC Repeated up to a maximum of 40 compressions. GDP: Vibration + –PC + DP 10min Untreated CG: manual chest contact 10min	HR (ppm) RR (cycles/min) SpO_2 (%) T1: before the procedure T2: 10min after T3: 30min after T4: 60min fater	GAD, GDP and CG without significant differences in T1 GAD: HR T1 55.59±10.12, T2 54.19±8.88, T3 50.26±8.65, T4 47.89±8.54 T1 vs T3 (p=0.0171) T2 vs T3 (p=0.0016) T2 vs T4 (p=0.0137) RR T1 147.67±17.75, T2 151.89±16.19, T3 144.00±17.35, T4 146.78±18.97 T2 vs T3 (p=0.0023) T2 vs T4 (p=0.0066) GDP: HR T1 55.11±11.30, T2 54.85±9.84, T3 51.22±8.67, T4 49.11±10.81 T1 vs T3 (p=0.0171) T2 vs T3 (p=0.0016) T2 vs T4 (p=0.0137) RR T1 155.11±21.46, T2 156.15±24.55, T3 147.81±16.85, T4 147.11±21.50 T1 vs T4 (p=0.0066) T2 vs T3 (p=0.0126) CG: HR T1 56.37±10.06, T2 56.37±9.68, T3 54.41±10.17, T4 55.00±8.66 T1 vs T3 (p=0.0171) T2 vs T3 (p=0.0016) T2 vs T4 (p=0.0137)

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Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Remondini, 2014	RCT	AVB Hospitalization and ICU G1: 14 (29.2%) ♀ + 34 (70.8%) ♂ 5.47 months 39 ICU + 9 hospitalization SpO_2<92%: 6 and ≥92:42 G2: 7 (20.0%) ♀ + 28 (80.0%) ♂ 6.28 months 34 ICU + 1 hospitalization SpO_2<92: 7 and ≥92:28	G1 and G2: bronchodilators and DP G1: puncture tracheal aspiration Antibiotics: 31 (64.6%) no Corticosteroids: 29 (60.4%) no G2: expiratory flow acceleration tracheal aspiration. Antibiotic: 19 (54.3%) no Corticosteroids: 13 (37.1%) no	Location (ward or ICU) SpO_2 (%) Severity of Lower Respiratory Tract Infection (LRTI) (1 to 17), where <4 is considered mild Moments: Before (0) 10min after session (10) 60min after session (60)	G1: Location: Ward 39 (81%) + ICU 9 Antibiotics: 48 (100%) SpO_2: <92%: 6 (0) vs 2 (10) vs 5 (60) (p=0.307) >92%: 42 (0) vs 46 (10) vs 43 (60) (p=0.307) LRTI: 5.02 (0) vs 3.06 (10) vs 3.13 (60) (p<0.001) G2: Location: Ward 34 (97%) + ICU 1 Antibiotics: 35 (100%) SpO2: <92%: 7 (0) vs 3 (10) vs 3 (60) (p=0.234) >92%: 28 (0) vs 32 (10) vs 32 (60) (p=0.234) LRTI: 5.8 (0) vs 3.6 (10) vs. (660) (p<0.001)
Rochat, 2012	RCT	AVB Hospitalization EG: 27♂ + 23♀ 110 (95) days 37 at first episode of bronchiolitis 37 with RSV ELISA 1 with another type of virus CG: 28♂ + 21♀ 108 (86) days 42 at first episode of bronchiolitis 37 with RSV ELISA 1 with another type of virus	Sessions two times per day CG: - rhinopharyngeal suction after administration of saline solution -oxygen to reach SpO_2≥92% -fractionated meals -nasal drops (xylometazoline) -antibiotics in cases of infection EG: -Same as the control group -PSE -EFA -PC	-Clinical score (feeding, vomiting, sleep quality) -Respiratory score (RR, SpO_2, presence and severity of retractions, adventitious respiratory sounds, presence of vesicular murmur, chest distention) -RR (cycles/min) -SpO_2 (%) -pH of capillary blood -capillary PCO2 (kPa) -Bicarbonates (mmol/l) Daily clinical assessments before physiotherapy sessions (in the EG)	EG: Clinical score: 0.73 (0.91) Respiratory score: 9.5 (3.6) RR: 53.2 (12.7) SpO_2: 91.9 (4.5) pH: 7.37 (0.06) PCO2: 5.73 (1.72) Bicarbonates: 23.1 (2.5) CG: Clinical score: 0.73 (0.96) Respiratory score: 9.5 (3.6) SpO_2: 92.4 (4.8) pH: 7.37 (0.05) PCO2: 6.11 (1.30) Bicarbonates: 24.3 (2.1) Clinical score: p=0.37 Respiratory score: p=0.044
Sánchez, 2004	Prospective OBS	AVB Hospitalization n=223 of 2 hospitals HUC: n=93 56% ♂ + 44% ♀ 6.6 months 26.9% with chronic respiratory pathology HSR: n=130 54% ♂ + 46% ♀ 2.5 ± 0.2 months 2.3% with chronic respiratory pathology	-supplemental oxygen -common adrenaline -salbutamol nebulization -systemic corticosteroid -antibiotics -RR	Length of stay (days) Difference in treatments in different centers (%)	HUC vs HRS Age: 6.6 vs 2.5 (p<0.001) Hospital days: 3 vs 4 (p<0.018) -common adrenaline: 44% vs 81% (p < 0.0001) -salbutamol nebulization: 90.3% vs 31.5% (p<0.0001) -RR: 54% vs 86% (p<0.0001)

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Table 1. Continuation

Author, year	Study type	Sample	Procedures	Evaluation	Results
Sánchez-Bayle, 2012	RCT	AVB Hospitalization CG: 41♀ + 59♂ 2.48±1.57 months 80% with respiratory stress 90% with exams 67% with RSV 37±1 ºC 95±4% SpO_2 EG: 55♀ + 81♂ 2.61±1.53 months 85% with respiratory stress 88% with exams 67% with RSV 37±1ºC 95±3% SpO_2	10min sessions, 2× a day CG: Placebo maneuvers (postural changes) Initial medication: -Adrenaline (54% of the sample) -Salbutamol (27%) -Ipratropium bromide (5%) -Antibiotics (37%) -Adrenaline (50%) EG: PSE + Vibration + PC Initial medication: -Adrenaline (50% of the sample) -Salbutamol (29%) -Ipratropium bromide (5%) -Antibiotics (39%) -Adrenaline (54%)	Hospitalization days Hours of oxygen therapy Final medication (% of sample)	Hospitalization days: EG (4.56±2.07) vs CG (4.54±1.72) Hours of oxygen therapy: GR (49.98±37.1) vs CG (53.53±38.87) (p=0.042). Final medication: -Adrenaline: EG (50%) vs CG (54%) -Salbutamol: EG (29.41%) vs CG (27%) -Ipratropium bromide: EG (5.14%) vs CG (5%) -Antibiotics: EG (38.97%) vs CG (37%)
Sebban, 2017	Prospective OBS	AVB Outpatient clinic 19 (6♀ + 13♂) Age (months) From 1 to 3: 8 (42.1%) From 3 to 6: 7 (36.8%) From 6 to 9: 3 (15.8%) From 9 to 12: 1 (5.3%)	1 physiotherapy session (2 hours and 30 minutes) consisting of techniques: RRC + Flow demodulation maneuver practice + PC Other treatments received: Bronchodilator, Corticotherapy, Antibiotics	Stratified Wang: <4: class 1: benign bronchiolitis (BB) <9: class 2: moderate bronchiolitis (MB) <12: class 3: severe bronchiolitis related to hospitalization decision (SB) Hospitalization Before and after (RR)	Wang of 4 [2-6] before and 2 [0-3] after RR (p < 0.01). BB: Before (31.6%) and after RR (94.7%) (p<0.0001) MB: before (63.2%) and after RR (5.3%) (p<0.0001) SB: before (5.3%) and after RR (0%) (p<0.001) Hospitalization before RR: 6 Hospitalization after RR: 0
Webb, 1985	RCT	Acute viral bronchiolitis Hospitalization 90 infants (CG=46; EG=44) 54♂ + 36♀ 4 – 6 months 69% RSV positive 36% family history of atopy 66% with smokers at home	CG: without RR EG: with RR -Cupped hand percussion (3min) -5 postural drainages -assisted coughing -oropharyngeal suction (2× daily)	Clinical score (maximum score: 30) HR, RR, hyperinflation, use of accessory muscles, recession, rhinitis, wheezing, coughing, crackling and snoring On admission, 1-5 days later	CG vs EG admission (46): 12 vs (44): 10 day 1 (45): 10 vs (42): 7 day 2 (39): 8 vs (38): 7 day 3 (31): 6 vs (28): 7 day 4 (21): 6 vs (16): 4 day 5 (18): 5 vs (11): 6

AB: acute bronchiolitis; EFI: expiratory flow increase; AVB: acute viral bronchiolitis; GenC: general conditions; PD: postural drainage; RRC: retrograde rhinopharyngeal clearance; PSE: prolonged slow expiration; CG: control group; EG: experimental group; HR: heart rate; RR: Respiratory rate; OBS: observational; RE: retractions; RCT: randomized controlled trial; SpO_2: oxygen saturation; AC: assisted cough; PC: provoked cough; ICU: intensive care unit; RSV: respiratory syncytial virus; WH: Wheezing.
Values are presented as mean±standard deviation. The results presented are those significant (with p-value), unless considered pertinent.

Retrograde rhinopharyngeal clearance (RRC) reduced wheezing and retractions[20]; when associated with PSE, it reduced retractions and increased SpO_2[17], and when associated with PC[21] it decreased hospitalization days and Wang's score. RRC showed no changes in Silverman's score[22]. Postural drainage (PD) associated with percussion and vibration did not decrease hospitalization days, supplemental oxygen or nasogastric feeding[23,24]; when associated with PC and oropharyngeal suction, it improved heart rate (HR), RR and SpO_2[22], and when associated with EFI and tracheal aspiration, it improved SpO_2, reduced the number of infants in ICU and reduced the severity of the condition[9]. Assisted autogenic drainage associated with intrapulmonary percussive ventilation was shown to be statistically significant in terms of days to discharge, Wang's clinical severity score, and heart rate[9].

Only two studies addressed mild and moderate viral bronchiolitis, with a decrease in hospitalization days and pathology severity[20], heart rate, respiratory rate, and Wang's score[17].

Regarding the care setting, 54% of the articles performed inpatient physiotherapy and of these, 64% showed fewer hours of oxygen therapy[21], hospitalization days[16,20,25], improved Wang's score[15,16,20], decrease HR[15,16,20,22], RR[16,22,26], adventitious sounds (reduction of retractions) and Downes' score[8], and increased SpO_2[15,18,22,26].

As for the studies (23%) that encompassed both inpatient and ICU settings, most showed positive results regarding hospitalization days[27], SpO_2[9,28,29], reduction in the number of infants in the ICU[9], reduction in disease severity[9], reduction in wheezing and retractions[28,30] and respiratory rate[29].

In studies (23%) with outpatient intervention, most (83%) showed some statistically significant positive outcome, namely in RR[17], HR[17,31], hospitalization days[21] and clinical severity scores[14,19,32].

DISCUSSION

There is no consensus on which physical therapy techniques are most suitable for the benefit of infants with acute viral bronchiolitis (ABV), despite positive results[33,34]. Only two studies found an improved HR with EFI associated with vibrating RRC, PC and PD[31] and autogenic drainage with intrapulmonary percussive ventilation[20], reinforcing the results of other authors[5].

We observed opposite results regarding the relationship between SpO_2 and severity (Wang), which had already been noted by Roqué i Figuls[6]. The studies included in this systematic review did not report any improvement when using PD associated with vibration and percussion[23,35], unlike a 2008 study in which it is associated with vibrocompression[36]. Regarding the Silverman's score, only one study obtained significant results when using RRC[14]. Studies show that application of the RRC technique in infants with acute viral bronchiolitis has immediate positive effects on the occurrence of complications and signs of respiratory effort when compared to nasopharyngeal aspiration. RRC seems to be a safe technique and can therefore be considered a possible alternative for treating infants with AVB and upper airway obstruction[20]. In agreement with the literature, RRC achieved significant improvements in airway auscultation and significantly decreased respiratory rate[37]. Finally, regarding the Downes' score, only one study showed significant improvements when performing EFI associated with vibration and nasotracheal aspiration[8]. According to Almeida-Júnior[38], when evaluating the effects of EFI on lung function in infants, significant improvements were found in all parameters. Although moderate bronchiolitis is less frequently addressed, studies reported significant improvements in hospitalization days and severity of the pathology[20], as well as in HR, RR and Wang's score[17], confirming that in moderate cases there is benefit in applying physical therapy[7]. There is no consensus regarding its effectiveness in reducing clinical severity, which can be explained by the fact, in the most severe cases, it is common not to use physical therapy[7]. Of the 26 selected articles, 54% were carried out in inpatient settings, with 64% reporting significant changes, and 23% in both inpatient and ICU settings and 23% in outpatient settings, with 83% observing significant changes, corroborating an outpatient study that showed that physical therapy had a positive impact on this population[39].

CONCLUSION

Evidence suggests good results of physical therapy techniques, namely RRC, PSE and EFI or PC, in airway permeabilization, promotion of bronchial hygiene, and comfort and recovery of functions in the population studied, regardless of disease severity and the care setting. It also showed positive results on hospitalization days, SpO_2, clinical score, HR, RR, and the need for oxygen therapy. A limitation of this systematic review is the lack of studies with robust and comparable methodologies, especially regarding the different severities of the pathology, to clarify the adequacy of interventions. We suggest that studies be carried out on patients with mild to moderate bronchiolitis who are not hospitalized.

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APPENDIX

I) PRISMA checklist

Section and Topic	Item	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Cover
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	2
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	x
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	2
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	2
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	2
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	2
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	2
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	x
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	2
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	x
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	2
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	x
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	x
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	x
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	x
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	x
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	2 – Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	2
Study characteristics	17	Cite each included study and present its characteristics.	Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	2+Annex II

(continues)

Continuation

Section and Topic	Item	Checklist item	Location where item is reported
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	x
Results of syntheses	20a	For each synthesis, briefly summarie the characteristics and risk of bias among contributing studies.	x
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Table 1
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	x
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	x
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	x
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	x
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	3-4
	23b	Discuss any limitations of the evidence included in the review.	4
	23c	Discuss any limitations of the review processes used.	x
	23d	Discuss implications of the results for practice, policy, and future research.	4
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	x
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Submission form
Competing interests	26	Declare any competing interests of review authors.	Declaration
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	y

II) QUALITY ASSESSMENT

Observational studies:

reviewer	Evenou 2017			Sebban 2017			Carroll, 2016			Gonçalves, 2014		
	1	2	both	1	2	both	1	2	both	1	2	both
1	Y	Y		Y	Y		Y	Y		Y	Y	
2	Y	Y		Y	Y		Y	Y		NR	Y	
3	Y	NR		Y	N		Y	Y		NR	Y	
4	Y	Y		Y	Y		Y	Y		N	N	
5	N	N		NR	N		NR	N		Y	Y	
6	Y	Y		Y	Y		Y	Y		Y	Y	
7	Y	Y		Y	N		Y	Y		N	N	
8	N	NA		N	Y		NO	N		N	N	
9	Y	Y		Y	Y		Y	N		Y	Y	
10	Y	Y		N	Y		NO	NA		Y	Y	
11	Y	Y		Y	Y		Y	Y		Y	Y	
12	N	N		N	N		NR	N		N	Y	
13	N	N		N	N		NR	NA		Y	NR	
14	NR	N		NR	N		NR	N		N	N	
Quality Rating	G	G	G	F	F	F	G	F	F	G	G	G

Experimental Studies with no Control Group:

reviewer	Postiaux, 2006			Barbie, 2009			Bernard-Narbonne, 2003			Castro, 2011			Halna, 2005			Sanchez, 2004		
	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both
1	Y	Y		Y	Y		Y	Y		Y	Y		Y	Y		Y	Y	
2	Y	Y		Y	N		Y	Y		Y	Y		Y	Y		Y	Y	
3	Y	NR		Y	NR		Y	NR		Y	NR		Y	Y		Y	Y	
4	N	NR		Y	N		Y	Y		Y	Y		Y	Y		Y	Y	
5	N	NR		N	NR		NR	NR		NR	NR		Y	Y		Y	Y	
6	Y	Y		Y	Y		Y	Y		Y	Y		Y	Y		Y	N	
7	Y	Y		Y	Y		Y	Y		Y	Y		Y	Y		Y	Y	
8	NR	N		N	N		NR	NR		NR	Y		NR	N		NR	NA	
9	Y	Y		NR	NR		NR	NR		NR	Y		NR	NR		NR	NR	
10	Y	Y		Y	Y		Y	Y		Y	Y		Y	Y		NO	NA	
11	Y	N		N	N		Y	Y		Y	Y		Y	Y		NO	NA	
12	NA	NA		Y	Y		Y	Y		Y	Y		Y	N		NO	N	
Quality Rating	F	F	F	F	P	P	G	G	G	G	G	G	G	F	G	P	P	P

Experimental Studies with Control Group:

reviewer	Nicholas, 1999			Pupin, 2009			Webb,1985			Rochat,2012			Bailleux, 2011			Bohé, 2004		
	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both
1	Y	Y		Y	N		Y	N		Y	Y		Y	Y		Y	Y	
2	Y	Y		NO	Y		NR	NA		Y	Y		NR	N		Y	Y	
3	NR	Y		NR	N		NR	N		Y	Y		NR	NR		Y	Y	
4	NR	N		NR	N		NR	N		Y	N		NR	Y		NR	NR	
5	NR	N		NR	NR		NR	N		NR	Y		NR	Y		NR	NR	
6	Y	Y		Y	Y		Y	Y		Y	Y		Y	Y		Y	Y	
7	Y	Y		NO	Y		NR	Y		NR	Y		NR	NR		NR	Y	
8	Y	Y		NO	Y		NR	Y		NR	Y		NR	NR		NR	Y	
9	Y	Y		Y	Y		Y	Y		Y	Y		Y	NR		Y	Y	
10	Y	N		NO	N		Y	Y		Y	Y		NR	Y		Y	Y	
11	Y	Y		Y	Y		Y	Y		Y	Y		NR	Y		NR	Y	
12	NR	N		NR	NR		NR	NR		NR	NR		NR	NR		NR	NR	
13	Y	Y		NO	Y		Y	Y		Y	Y		NR	Y		Y	N	
14	NR	Y		NO	Y		Y	Y		Y	Y		NR	Y		Y	Y	
Quality Rating	F	F	F	P	F	F	P	P	P	G	G	G	P	P	P	G	F	F

reviewer	Jacinto, 2013			Sánchez Bayle, 2012			Ginderdeuren, 2017			Gadjos, 2010			Conesa-Segura, 2019			Remondini, 2014		
	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both
1	Y	N		Y	Y		Y	Y		NR	Y		Y	Y		Y	Y	
2	NR	NA		Y	Y		Y	Y		Y	Y		Y	Y		Y	NR	
3	NR	NA		Y	Y		Y	Y		Y	Y		Y	Y		Y	NR	
4	NR	NA		N	N		N	Y		N	N		N	N		Y	N	
5	NR	N		Y	N		Y	Y		Y	Y		Y	Y		NR	N	
6	Y	N		Y	Y		Y	Y		Y	Y		Y	Y		NR	N	
7	NR	Y		N	N		Y	Y		Y	Y		Y	Y		Y	Y	
8	NR	Y		N	N		Y	Y		Y	Y		Y	Y		Y	Y	
9	Y	NR		Y	Y		N	Y		N	Y		Y	Y		NR	Y	
10	Y	Y		N	Y		N	Y		Y	Y		Y	Y		Y	Y	
11	Y	Y		Y	Y		Y	Y		Y	Y		Y	Y		Y	Y	
12	NR	NR		N	Y		Y	NR		N	N		Y	Y		Y	NR	

(continues)

Continuation

reviewer	Jacinto, 2013			Sánchez Bayle, 2012			Ginderdeuren, 2017			Gadjos, 2010			Conesa-Segura, 2019			Remondini, 2014		
	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both	1	2	both
13	NR	N		Y	Y		Y	Y		Y	Y		Y	Y		Y	Y	
14	NR	NA		Y	Y		Y	Y		Y	Y		Y	Y		Y	Y	
Quality Rating	P	P	P	G	G	G	G	G	G	G	G	G	G	G	G	F	F	F

reviewer	Gomes, 2016			Postiaux, 2011			Gomes, 2012			González-Bellido, 2021		
	1	2	both	1	2	both	1	2	both	1	2	both
1	Y	Y		Y	Y		Y	Y		Y	Y	
2	Y	Y		Y	Y		Y	Y		Y	N	
3	Y	Y		Y	Y		Y	Y		Y	N	
4	N	NR		N	N		N	N		N	N	
5	Y	NR		Y	Y		Y	Y		Y	Y	
6	Y	Y		Y	Y		Y	Y		Y	Y	
7	Y	Y		Y	Y		Y	Y		Y	Y	
8	N	Y		N	Y		N	N		N	Y	
9	Y	Y		Y	Y		Y	Y		Y	Y	
10	N	N		Y	Y		N	N		N	NR	
11	Y	Y		Y	Y		Y	Y		Y	Y	
12	Y	Y		Y	NR		Y	NR		Y	NR	
13	Y	Y		Y	Y		Y	Y		Y	Y	
14	Y	Y		Y	Y		Y	Y		Y	Y	
Quality Rating	G	G	G	G	G	G	G	G	G	G	G	G

Quality Rating: G: Good; F: Fair; P: Poor.