

Efficacy of Speech-language Pathology Therapy in Chronic Cough: Systematic Review With Meta-analysis

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Summary: Objectives. To analyze the efficacy of speech-language pathology therapy in the self-assessment, in the cough frequency, and the vocal quality of adults with chronic cough.

Methods. This is a systematic review with meta-analysis that answered the clinical question: "In adults with chronic cough, what is the effect of the speech-language pathology therapy in the self-assessment, in the cough frequency, and the vocal quality, compared to another intervention?" (PROSPERO 2021/CRD42021226729). An electronic search (MEDLINE, Web of Science, EMBASE, SCOPUS, Cochrane Library, and Lilacs), and a manual search (Journal of Voice, Brazilian Library of Theses and Dissertations, Open Grey and Clinical Trials) with specific search strategies was performed. The risk of bias was assessed using the Cochrane Collaboration's tool for assessing the risk of bias in randomized trials. Meta-analysis (standardized difference of means, Inverse Variance, and random effects model) and heterogeneity analysis (Chi^2 , Tau^2 , and I^2) were performed.

Results. We found 610 studies and selected three. There was an uncertain risk of detection bias. The data were heterogeneous, and there was no difference between interventions in self-perception of cough severity ($z = 0.09$, $P = 0.930$; $\text{tau}^2 = 0.65$, $I^2 = 90\%$) and in the self-perception of the effects of chronic cough on health status ($z = 0.30$, $P = 0.77$; $\text{tau}^2 = 0.99$, $I^2 = 97\%$). The estimated mean difference was 0.97 to cough frequency, and it was differ significantly from zero ($z = 4.47$, $P < 0.001$) but the results are heterogeneous ($\text{Chi}^2 (1) = 22.22$, $P < 0.001$, $I^2 = 95\%$).

Conclusion. The speech-language pathology therapy had a greater effect size than the control interventions on cough frequency. However, in the subjects' perception, there were no differences between the interventions.

Key Words: Chronic cough—Speech-language pathology therapy—Systematic review.

INTRODUCTION

Cough is a physiologic reflex defense mechanism to clean the lower airways.¹ It can be classified according to its duration, ie, acute cough (lasting less than 3 weeks), subacute cough (lasting from 3 to 8 weeks), or chronic cough (lasting more than 8 weeks).² In cases³⁻⁵ that the chronic cough is resistant to medical treatment, it is called chronic refractory cough.

The chronic cough's main symptoms are a sensation of tickling, discomfort, laryngeal irritation, or sensitivity which will stimulate the cough reflex.¹ Chronic cough may negatively impact the quality of life regarding social, physiological, and physical aspects.⁶ Coughing can also result in phono-traumatic behaviors.⁷

The treatment of cough includes pharmaceutical treatment with antitussive,^{8,9} and recently cough suppression

therapy.⁵ This cognitive-behavioral approach aims the refractory chronic cough suppression by breaking the cycle of reciprocal irritation of cough receptors, and it is used especially when medical intervention has failed.¹⁰ The reduction of exposure to laryngeal irritants, such as oral breathing, gastro-esophageal reflux, alcohol intake, among others, will reduce phono-traumatic behaviors due to constant coughing.

The speech-language pathology therapy for chronic cough aims to suppress cough, reduce cough reflex sensitivity, ie, increase cough reflex threshold and, reduce laryngeal irritation. Thus, the therapy includes counseling on cough and laryngeal well-being; cough suppression, control, or replacement; and improving the respiratory and laryngeal control.^{7,10}

The speech-language pathology therapy for chronic cough is recent; nonetheless, they present positive outcomes regarding self-perception and cough frequency.^{3,11} In addition, there is improvement in the vocal quality of patients who had presented vocal deviations due to phono trauma related to coughing.³ However, speech-language pathology therapy still lacks consensus regarding the procedures and outcomes. The comparison between speech-language pathology therapy and other intervention, such as indirect therapy and pharmaceutical treatment, may contribute to the speech-language pathology management of chronic cough.

This study aimed to analyze the efficacy of speech-language pathology therapy in the self-assessment, in the cough

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frequency, and the vocal quality of adults with chronic cough.

METHODS

This study is a systematic review with meta-analysis (SRM) of effectiveness. The protocol was registered at PROSPERO (2021/CRD42021226729). The study followed the PRISMA guideline.¹²

The study design followed the PICO strategy where:

P (patient): over 18 years old, with the diagnosis of chronic cough

I (intervention): traditional speech-language pathology therapy (association between direct and indirect interventions)

C (comparison): counseling, guidance, or pharmacological therapy associated or not with traditional speech-language pathology therapy

O (outcomes): (1) self-assessment of the cough (self-assessment of cough severity using visual analogue scale (VAS) or symptom frequency and severity rating, self-assessment of the effects of chronic cough on health status using the Leicester Cough Questionnaire [LCQ]¹³); (2) cough frequency using the Leicester Cough Monitor [LCM]¹⁴; and (3) perceptual-judgment of the vocal degree of deviation using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V).¹⁵

The research question was: In individuals with chronic cough, what is the effect of the speech-language pathology therapy in the cough frequency, in the self-assessment, and the vocal quality when compared to another intervention?

Electronic and manual searches were performed. The electronic searches included MEDLINE, Cochrane Library, EMBASE, Web of Science, SCOPUS, and LILACS database. The specific search strategies are described in Figure 1. The manual search was performed directly in the Journal of Voice, in the Brazilian Digital Library of Theses and Dissertations (BDTD), OpenGrey, and Clinical Trials. In addition to scanning the citations of the included articles.

Two independent authors performed the search, selection, data extraction, and the risk of bias analysis.

Eligibility criteria were established to perform the selection. The inclusion criteria were: participants over 18 years old; the presence of a medical diagnosis of chronic cough; intervention with traditional speech-language pathology therapy with direct and indirect interventions; comparison with counseling, guidance, or pharmacological therapy associated or not with traditional speech-language pathology therapy; evaluation before and after the intervention including self-assessment of the cough severity using VAS or symptom frequency and severity rating, self-assessment of the effects of chronic cough on health status using the LCQ,¹³ cough frequency using the LCM,¹⁴ or perceptual-judgment of the vocal degree of deviation using the CAPE-V.¹⁵

The exclusion criteria were: children or patients without chronic cough diagnosis; not undergo speech-language

pathology therapy; no control/comparison group; comparison with traditional speech-language pathology therapy; no self-assessment of the cough severity using VAS or symptom frequency and severity rating, self-assessment of the effects of chronic cough on health status using the LCQ, no assessment of cough frequency using LCM, or perceptual-judgment of the vocal degree of deviation using the CAPE-V; evaluation before and after the intervention. The selection procedures of the articles were: (1) reading the title and abstract to verify the inclusion criteria and (2) reading the full article to verify the exclusion criteria.

The risk of bias was assessed independently by two authors using the Cochrane Collaboration's tool for assessing risk of bias in randomized trials. A third author analyzed disagreements.

The qualitative data were extracted according to the publication (authors, year, country, and design), the sample (gender, age, and diagnosis), and the experimental and control interventions (group size, number of sessions, intervention, and session time). The quantitative data were also extracted for the meta-analysis: analysis of self-assessment of cough severity using VAS or symptom frequency and severity rating; analysis of self-assessment of the effects of chronic cough on health status using the LCQ; analysis of cough frequency using the LCM; analysis of the overall degree of vocal deviation using the CAPE-V.

The qualitative data were individually described. The meta-analysis of continuous quantitative variables was performed considering the standardized difference of means, the Inverse Variance statistical test, and the random-effects model. The heterogeneity analysis used the Tau² test, Chi² test, and the I² statistic. The meta-analysis and risk of bias were performed with the Review Manager 5 software.

RESULTS

Figure 2 presents the flow diagram for searching and selecting articles. The electronic searches found 289 studies (MEDLINE = 24; EMBASE = 17; WEB OF SCIENCE = 198; COCHRANE LIBRARY = 10; SCOPUS = 40; LILACS = 0) and the manual search found 319 studies (Clinical Trials = 3; Thorax = 1; Chest = 1; Journal of Voice = 312; BDTD = 0; OpenGrey = 0; Citation searching = 2). A total of 45 studies were excluded from the electronic search due to duplicity; hence, 244 studies were initially considered. By reading the title and abstract, 35 articles were included; next, 34 articles were excluded according to the exclusion criteria. Three articles were selected from the manual search. After reading the full articles, one was excluded according to the inclusion and exclusion criteria. Two studies were excluded for not being found complete in manual search, and 315 for other reasons. Therefore, three articles were selected for further analysis.

Two studies^{11,16} had unclear detection bias (Figure 3). Overall, the present Systematic Review with Meta-analysis

Search Strategies	
MEDLINE	((("Cough"[Mesh] OR "Chronic Cough"[Title/Abstract]) AND ("Voice Training"[Mesh] OR "Vocal Therapy"[Title/Abstract] OR "speech pathology management"[Title/Abstract] OR "behavioral management"[Title/Abstract] OR "Speech pathology treatment"[Title/Abstract]))
Cochrane Library	("chronic cough" OR "cough") in Title Abstract Keyword AND ("Voice Training" OR "Vocal Therapy" OR "speech pathology management" OR "Speech pathology treatment") in Title Abstract Keyword - (Word variations have been searched)
EMBASE	('chronic cough':ti,ab,kw OR coughing:ti,ab,kw) AND ('voice training':ti,ab,kw OR 'vocal therapy':ti,ab,kw OR 'speech pathology management':ti,ab,kw OR 'speech pathology treatment':ti,ab,kw)
Web of Science	All fields: ((cough* OR chronic cough*)) AND All fields: ((Voice Training* OR Vocal Therapy* OR speech pathology management* OR Speech pathology treatment*))
SCOPUS	(TITLE-ABS-KEY ("Cough" OR "Chronic Cough") AND TITLE-ABS-KEY ("Voice Training" OR "Vocal Therapy" OR "speech pathology management" OR "behavioral management" OR "Speech pathology treatment"))
LILACS	(mh:(("cough")) AND ((mh:(("voice training")) OR (tw:("speech pathology management")) OR (tw:("vocal therapy")) OR (tw:("speech pathology treatment"))))

FIGURE 1. Electronic search strategies per database.

(SRM) presented a 67% risk of unclear detection bias (Figure 4).
Chart 1 shows that the studies were published between 2006 and 2017; most studies are from Australia. All articles were experimental studies. Frequently, the sample

characterization were patients of both genders, mean aged between 56 and 64 years old and diagnosed with chronic cough. The number of participants ranged from 20 to 44. Most interventions consisted of four sessions. The sessions lasted from 30 to 60 minutes. Regarding the intervention

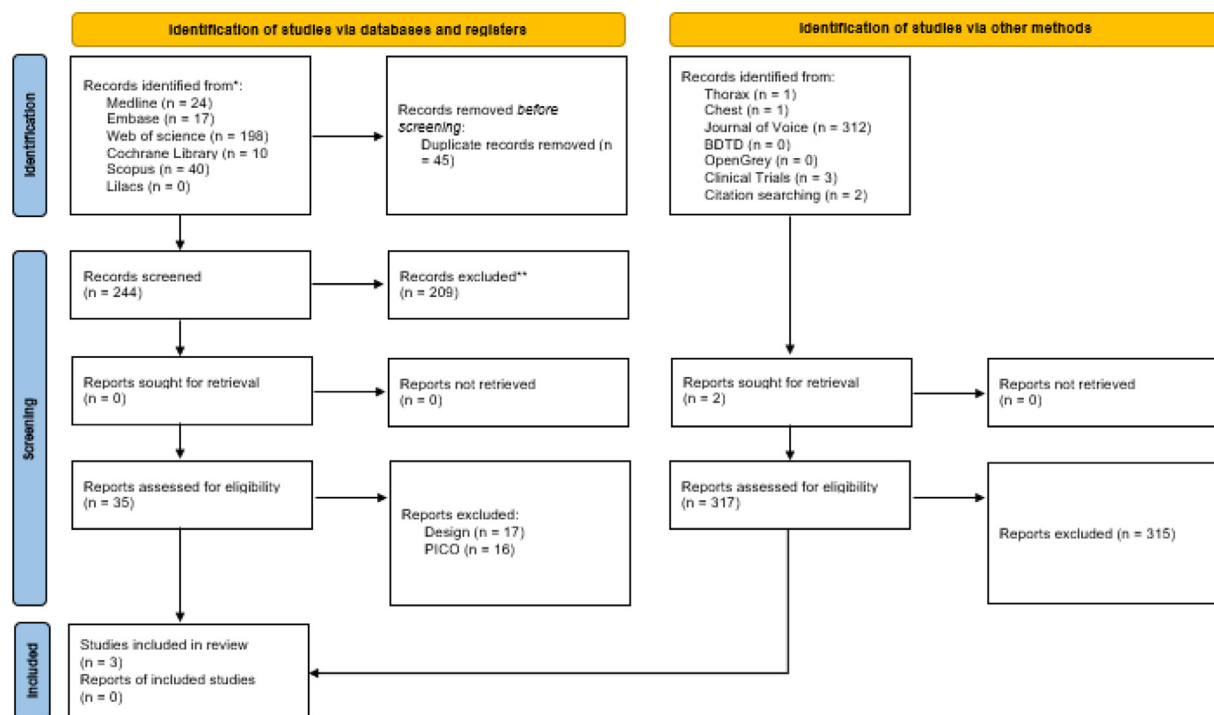


FIGURE 2. Flow diagram for searching and selecting studies.

groups, the intervention program of the Experimental Group was heterogeneous, and the Control Group was more frequently submitted to the Healthy Life Style Education.

Two studies^{3,11} included the analysis of self-assessment of the effects of chronic cough on health status (Figure 5). Based on the random-effects model, the estimated mean difference was -0.21 (CI 95%: -1.62 to 1.19). Thus, the mean result did not differ significantly from zero ($z = 0.30$, $P = 0.77$). The true results are heterogeneous ($\text{Chi}^2 (1) = 29.08$, $P < 0.001$, $\tau^2 = 0.99$, $I^2 = 97\%$).

Three studies^{3,11,17} included the analysis of self-assessment of cough severity (Figure 6). The estimated mean difference based on the random-effects model was -1.09 (CI 95%: -0.91 to 1.00). Thus, the mean result did not differ significantly from zero ($z = 0.09$, $P = 0.930$). The true results are heterogeneous ($\text{Chi}^2 (2) = 20.88$, $P < 0.001$, $\tau^2 = 0.65$, $I^2 = 90\%$).

Two studies^{3,11} included the analysis of the cough frequency. The mean difference ranged from -0.12 to 1.92. Based on the random-effects model, the estimated mean difference was 0.97 (95% CI: -0.54 to 1.39) (Figure 7). Therefore, the mean result differed significantly from zero ($z = 4.47$, $P < 0.001$). The true results are heterogeneous ($\text{Chi}^2 (1) = 22.22$, $P < 0.001$, $I^2 = 95\%$).

It was impossible to perform the meta-analysis with the overall degree of vocal deviation once only one study presented outcomes. Table 1 shows that the individual results point to a greater improvement in the experimental group.

DISCUSSION

Chronic cough is an important topic gaining ground in speech-language pathology in the last two decades, with the pioneering work of an Australian group in recent years.^{3,17,18} However, the nonpharmacological intervention performed by speech-language pathologists consisting of

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Mitchell et al 2017	+	+	+	?	+	+	+
Vertigan et al 2006	+	+	+	?	+	+	+
Vertigan et al 2016	+	+	+	+	+	+	+

FIGURE 3. Individual risk of bias.

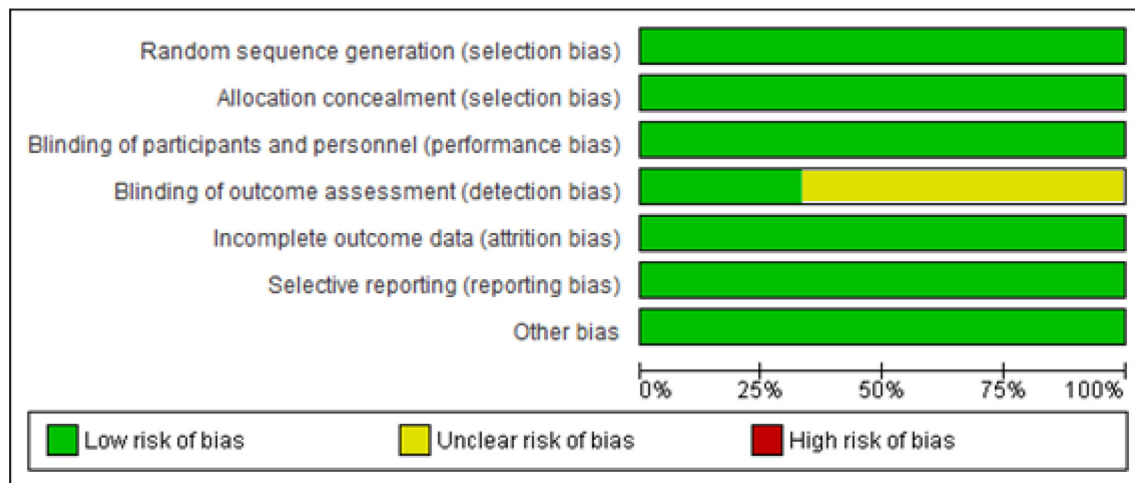


FIGURE 4. Individual risk of bias of the systematic review.

direct and indirect therapy still lacks more evidence about its effectiveness than other nonpharmacological and pharmacological therapies. Thus, this study aimed to analyze the efficacy of traditional speech-language pathology therapy in adults with chronic cough.

All articles were experimental studies with sample randomization and intervention control, hence, randomized clinical trials. Despite this, some studies did not report important information regarding the blinding of evaluators, therefore presenting an uncertain risk of detection bias.¹⁹ The detection bias is related to the blinding method of the evaluators regarding which intervention the patient performed. Although blinding is not a requirement for the randomized clinical trial, it is necessary to ensure that there is no bias in the measurement of outcomes due to the professional's awareness of the intervention group of the participants.

Australia has attracted attention for the high quality of studies related to chronic cough in the speech-language pathology field. They counted with two^{3,17} of the three selected studies in this review, all from the same research group. The studies included only men¹¹ or women,³ and both genders.¹⁷ There is no consensus on the prevalence of chronic cough in men or women; there are reports of higher prevalence in men²⁰ while there are reports of high prevalence in women.²¹ According to the literature, the chronic cough onset is more frequent in middle age,²¹ according to the present study whose participants were between 56 and 64 years old. There was high variability in the number of participants per study, from 20²² to 44 participants.³ The sample size is important to reduce the risk of type II error.²³ It is noteworthy to highlight the absence of sample calculation; thus, it was impossible to verify if the number of patients was enough to analyze the effectiveness of an intervention method. This weakness can be easily adjusted in future studies.

Two studies had four intervention sessions,^{11,17} and one study had five.³ A systematic review regarding nonpharmacological interventions for chronic refractory cough²¹

showed that two to four sessions of education, cough suppression techniques, breathing exercises, and counseling are enough to achieve positive results. The session time in two studies^{11,17} ranged between 30 and 60 minutes, and one study³ did not specify the session time. The literature brings no consensus regarding the optimal time per session. However, the values are similar to another systematic review¹⁹ with a maximum session time of 60 minutes. Session time is an important parameter, and no data on this aspect makes it impossible to replicate the intervention. There was no standardization of the speech-language pathology therapy method. However, it is observed that all obey a similar pattern composed of education about the cough aspects and vocal hygiene, strategies to control the cough, and psycho-educational counseling.¹⁸ Regarding the control group, the healthy lifestyle education intervention was more common.^{11,17} It consists of four components: relaxation, stress management, exercise, and diet.¹⁸ One study associated speech-language pathology and pharmacological intervention.³

The meta-analysis was performed to assess the self-assessment of cough severity and effects of chronic cough on health status. Self-assessment questionnaires are important strategies used to assess data regarding the patient's perception of cough.²⁴ The questionnaires that assess the impact of a given problem or symptom severity explore the influence that the person's perception has on his daily life, culture and, values regarding his aims, expectations, standards and, worries.²⁵ In addition to health, physical, emotional, mental, and functional factors include daily life, work, family, and friends.^{26,27} The patient's perspective regarding their disorder and their improvements are important for the monitoring process during the treatment. It is a simple, fast and, low-cost analysis, easier than other assessments used in speech-language pathology practice.

In this review, the experimental groups that underwent speech-language pathology therapy alone did not have a larger effect size when compared to the control group in any of the self-assessment outcomes. One of the meta-analyses

CHART 1.
Descriptive Analysis of the Qualitative Characteristics of the Studies

Authors	Country	Design	Gender	Age (mean)	Diagnosis	EG		CG
						n	Session Number	
n	Session Number				Intervention		Session Time (minutes)	
Vertigan et al 2006	Australia	RCT	Both	CC	43	4	44	30
								Healthy lifestyle education
Vertigan et al 2016	Australia	RCT	Female	RCC	20	5	20	-
								Speech pathology treatment + pregabalin
Mitchell et al 2017	United Kingdom	RCT	Both	CC	34	4	41	45-60
								Healthy lifestyle advice

Abbreviations: CC, chronic cough; CG, control group; EG, experimental group; RCC, refractory chronic cough; RCT, randomized clinical trial.

Abbreviations: CC, chronic cough; CG, control group; EG, experimental group; RCC, refractory chronic cough; RCT, randomized clinical trial.

analyzed the effects of chronic cough on health status using the LCQ, an instrument that assesses the self-reported quality of life measure of chronic cough considering different aspects of the patient's life.²⁴ There was no difference in effect size in this analysis, and the true results were heterogeneous. One study¹¹ compared the isolated speech-language pathology therapy with a control group that underwent indirect interventions, and the speech-language pathology therapy showed better results than indirect interventions. However, one study³ compared speech-language pathology therapy with a control group that underwent speech pathology therapy associated with pharmacological treatment using Pregabalin; and the control group presented better outcomes. Pregabalin is an anti-cough drug that acts directly on the symptoms reducing laryngeal sensations, possible cough triggers. It is a psychoactive drug that may alter the individual's behavior, conscience, and perception of cough severity.³ Although the individual results in the study did not show differences between the interventions in the cough frequency, the potential effect of the drug on laryngeal sensations may have provided better effects of chronic cough on health status. However, it is noteworthy that Pregabalin is a neuromodulator with a fast and short duration action mechanism; its withdrawn will not maintain the treatment effect. Probably, the effect was sustained after treatment due to the speech-language pathology therapy effect on behavioral changes and cough mechanisms.³ Despite the positive effect of this drug, Pregabalin can be associated with dizziness and falls, which was observed in one of the studies.³ The drug is used with speech-language pathology therapy must be analyzed individually by a physician. Furthermore, this data was observed in only one publication³; more studies are needed to confirm this outcome. The speech-language pathology therapy varied; however, the programs included counseling on hygiene and psychological aspects, cough suppression strategies, and respiratory and laryngeal control exercises. The counseling provides information regarding the nature of cough, laryngeal hygiene, reduction of laryngeal irritation, and psychological aspects.^{1,2,10} Cough suppression helps patients control their cough with strategies that identify, prevent, suppress or replace the cough.^{1,10} Finally, respiratory and laryngeal control trains breathing, voice production and provides better breathing and speaking coordination using exercises and guidance.¹⁰

No statistical difference was observed in the second meta-analysis with the self-assessment of the cough severity; also, the results were heterogeneous. There was variability in the comparison group; a study associated speech-language pathology therapy with pharmacological treatment,³ and the other two studies performed indirect therapy.^{11,17} The study that associated speech-language therapy with another intervention in the control group obtained better outcomes when compared to isolated speech-language therapy. In addition, the studies where the control group underwent Healthy Life Style Education presented the worst outcomes.^{11,17} This result may be due to the presence in the

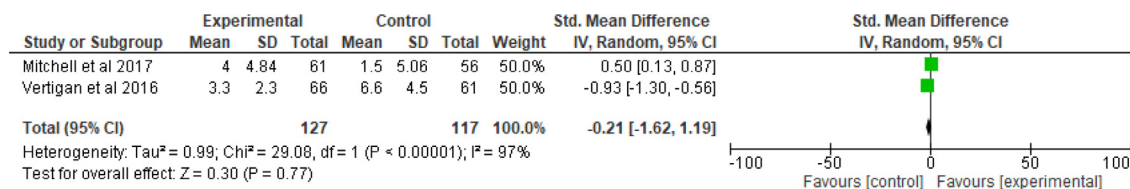


FIGURE 5. Forest plot of the analysis of self-assessment of the effects of chronic cough on health status.

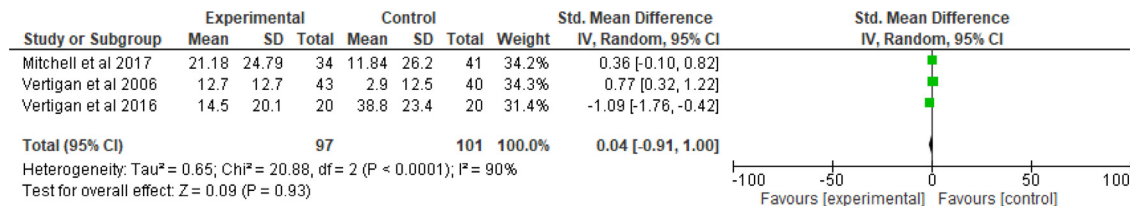


FIGURE 6. Forest plot of the analysis of self-assessment of cough severity.

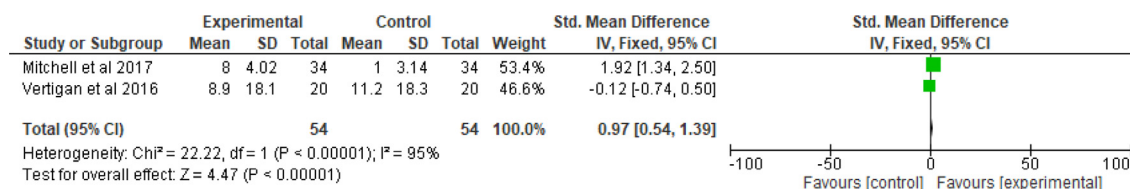


FIGURE 7. Forest plot of the analysis of cough frequency.

experimental group of a traditional speech-language pathology therapy that included education for a healthy lifestyle as one of its components; thus, better outcomes for the intervention are expected.

Although self-assessment is an important dimension that reflects the unique experience of patients who suffer from chronic cough, objective measures are also necessary. In the present SRM, the objective measures provided information regarding cough frequency and additional measures regarding the overall degree of vocal deviation.

Regarding the analysis of the cough frequency, there was a greater effect size with speech-language pathology therapy than other indirect speech-language pathology therapy or traditional speech-language pathology therapy associated with pharmaceutical treatment. This result needs to be interpreted carefully, as there was heterogeneity in the results. The heterogeneity resulted from the individual results of the studies. For one study,¹¹ the speech-language pathology

therapy presented better outcomes; for another study,³ better outcomes were observed for the speech-language pathology therapy and pharmaceutical treatment. The LCM is a validated instrument to assess the cough frequency. Currently, it is the best tool to objectively assess chronic cough in research and clinical practice.²⁸ Traditional speech-language pathology therapy uses several ingredients for the management of chronic cough in order to break the cycle of reciprocal irritation of cough receptors.¹⁶ The mechanism underlying a possible better effect with traditional speech therapy observed in this SRM is not fully elucidated. However, it may be due to the ingredient of cough suppression, control, and replacement^{29,30} and the ingredients to reduce cough reflex sensitivity^{29,30} and the laryngeal irritation²⁹ that also are in the education for a healthy lifestyle. The cough suppression, control, and substitution component seek to cause the patient to learn to anticipate when a cough will occur and thus prevent and/or stop cough episodes. For

TABLE 1.
Individual Descriptive Analysis of the Overall Degree of Vocal Deviation

Authors	The Overall Degree of Vocal Deviation			
	Mean Difference Pre & Post EG	SD Difference Pre & Post EG	Mean Difference Pre & Post CG	SD Difference Pre & Post CG
Vertigan et al 2006				
Vertigan et al 2016	11.1	15.6	9	18.2
Mitchel et al 2017				

Abbreviations: CG, control group; EG, experimental group; SD, standard deviation.

this purpose, cough mapping, training techniques to distract attention focus, suppression techniques, and cough control techniques are commonly used.¹⁰

The overall degree of vocal deviation using the CAPE-V¹⁵ was used in one study. This study³ had a better outcome with the speech-language pathology therapy than in the control group. Patients frequently report talking as a trigger for coughing.³¹ Different mechanisms are proposed to link vocal deviation and chronic cough. When talking and laughing, the reduction in the lower esophageal sphincter tonus can lead to cough, or the vocal fold adduction during phonation may stimulate the laryngeal pressure receptors and lead to cough.³² The vocal quality due to cough may have the presence of hoarseness, breathiness, and strain. There are different degrees of laryngeal hyperresponsiveness, altered glottic closure, irregularities in vocal fold vibration and, paradoxical movements of the vocal folds. More primary studies are needed so that this outcome can be synthesized and analyzed.

Overall, there was no homogeneity in speech-language pathology therapy presenting better effects than other interventions, with the effect size being greater only for cough frequency. A qualitative interpretation of the results shows that speech-language pathology therapy, with axes that incorporate education about a healthy lifestyle, seems to have better results than an intervention that only addresses education about a healthy lifestyle. However, the association of traditional speech-language pathology therapy with other interventions such as pharmacological ones can optimize the results. More primary studies are needed so that SRM studies can present more consistent results.

As a limitation of this RSM, the limited number of studies is highlighted and the heterogeneity of existing studies. Future studies should include sample calculations, standardized outcome measures, and control group. Thus, the synthesized data will help the clinician choose the best intervention for the treatment of chronic cough.

This review's limitations are the unclear detection bias, the limited number of studies, and the heterogeneity between studies.

CONCLUSION

The speech-language pathology therapy had a greater effect size than the control interventions on cough frequency, but the results were heterogeneous. However, in the subjects' perception, there were no differences between the interventions.

DECLARATION OF COMPETING INTEREST

There are no conflicts of interest to declare.

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