

Supplementary material

Search strategies

Efficacy of interventions aiming at improving respiratory function after stroke: A systematic review.

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Databases: MEDLINE, LILACS, PEDro, and CINAHL

MEDLINE

1. cerebrovascular disorders/ or exp basal ganglia cerebrovascular disease/ or exp brain ischemia/ or exp carotid artery diseases/ or exp intracranial arterial diseases/ or exp "intracranial embolism and thrombosis"/ or exp intracranial hemorrhages/ or stroke/ or exp brain infarction/ or vertebral artery dissection/
2. (stroke or poststroke or post-stroke or cerebrovasc\$ or brain vasc\$ or cerebral vasc\$ or cva\$ or apoplex\$ or SAH).tw.
3. ((brain\$ or cerebr\$ or cerebell\$ or intracran\$ or intracerebral) adj5 (isch?emi\$ or infarct\$ or thrombo\$ or emboli\$ or oclus\$)).tw.
4. ((brain\$ or cerebr\$ or cerebell\$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage\$ or hemorrhage\$ or haematoma\$ or hematoma\$ or bleed\$)).tw.
5. hemiplegia/ or exp paresis/
6. (hemipleg\$ or hemipar\$ or paresis or paretic).tw.
7. or/1-6
8. breathing exercises/
9. respiratory therapy/
10. respiration/ or inhalation/ or exhalation/
11. exp inspiratory capacity/
12. exp respiratory muscles/
13. ((respirat\$ or inspirat\$ or expirat\$ or ventilat\$ or pulmonary) adj5 (therap\$ or train\$ or retrain\$ or exercise\$ or resist\$ or conditioning or strength\$ or weakness or endurance or muscle\$)).tw.
14. ((breathing or inhalation or exhalation) adj5 (exercise\$ or therap\$ or train\$ or retrain\$)).tw.
15. or/8-14
16. 7 and 15
17. exp animals/ not humans.sh.
18. 16 not 17
19. Randomized Controlled Trials as Topic/
20. random allocation/
21. Controlled Clinical Trials as Topic/
22. control groups/
23. clinical trials as topic/ or clinical trials, phase i as topic/ or clinical trials, phase ii as topic/ or clinical trials, phase iii as topic/ or clinical trials, phase iv as topic/
24. double-blind method/
25. single-blind method/
26. Placebos/
27. placebo effect/

28. cross-over studies/
29. Therapies, Investigational/
30. Research Design/
31. evaluation studies as topic/
32. randomized controlled trial.pt.
33. controlled clinical trial.pt.
34. (clinical trial or clinical trial phase i or clinical trial phase ii or clinical trial phase iii or clinical trial phase iv).pt.
35. (evaluation studies or comparative study).pt.
36. random\$.tw.
37. (controlled adj5 (trial\$ or stud\$)).tw.
38. (clinical\$ adj5 trial\$).tw.
39. ((control or treatment or experiment\$ or intervention) adj5 (group\$ or subject\$ or patient\$)).tw.
40. (quasi-random\$ or quasi random\$ or pseudo-random\$ or pseudo random\$).tw.
41. ((multicenter or multicentre or therapeutic) adj5 (trial\$ or stud\$)).tw.
42. ((control or experiment\$ or conservative) adj5 (treatment or therapy or procedure or manage\$)).tw.
43. ((singl\$ or doubl\$ or tripl\$ or trebl\$) adj5 (blind\$ or mask\$)).tw.
44. (coin adj5 (flip or flipped or toss\$)).tw.
45. versus.tw.
46. (cross-over or cross over or crossover).tw.
47. placebo\$.tw.
48. sham.tw.
49. (assign\$ or alternate or allocat\$ or counterbalance\$ or multiple baseline).tw.
50. controls.tw.
51. or/19-50
52. 18 and 51

LILACS

1. AVC OR “acidente vascular” OR AVE OR derrame OR hemiparesia OR hemiparéticos OR hemiparético OR paresia OR parético OR paréticos OR hemiplegia OR hemiplégico OR hemiplégicos OR isquêmico OR hemorrágico
2. Respiratório OR respiratórios OR respiração OR inspiração OR inspiratório OR inspiratórios OR expiração OR expiratório OR expiratórios OR ventilatório OR ventilatórios OR ventilação OR pulmonar OR diafragma OR abdominais
3. treino OR treinamento OR força OR fraqueza OR fortalecimento OR exercícios OR exercício OR condicionamento OR terapia OR retreino OR resistência OR endurance
4. 1 and 2 and 3

PEDro

- 1) Abstract & Title: Stroke OR Hemiparetic OR Hemiparesis
Therapy: respiratory therapy OR Strength Training
Problem: no selection
Body part: no selection
Subdiscipline: no selection
Method: Clinical Trial

CINAHL

1. (MH "Cerebrovascular Disorders+") or (MH "stroke patients") or (MH "stroke units")
2. TI (stroke or poststroke or post-stroke or cerebrovasc* or brain vas* or cerebral vas* or cva or apoplex or SAH) or AB (stroke or poststroke or post-stroke or cerebrovasc* or brain vas* or cerebral vas* or cva or apoplex or SAH)
3. TI (brain* or cerebr* or cerebell* or intracran* or intracerebral) or AB (brain* or cerebr* or cerebell* or intracran* or intracerebral)
4. TI (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*) or AB (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*)
5. S3 and S4
6. TI (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) or AB (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid)
7. TI (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*) or AB (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*)
8. S6 and S7
9. (MH "Hemiplegia")
10. TI (hemipleg* or hemipar* or paresis or paretic) or AB (hemipleg* or hemipar* or paresis or paretic)
11. S1 or S2 or S5 or S8 or S9 or S10
12. (MH "Breathing Exercises (SabaCCC)") OR (MH "Breathing Exercises+")
13. (MH "Education, Respiratory Therapy") OR (MH "Home Respiratory Care") OR (MH "Inspiration, Respiratory") OR (MH "Respiratory Muscles+") OR (MH "Respiratory Nursing") OR (MH "Respiratory Nursing Society") OR (MH "Respiratory Therapists") OR (MH "Respiratory Therapy+") OR (MH "Respiratory Therapy Equipment and Supplies+") OR (MH "Respiratory Therapy Service")
14. (MH "Respiration (Omaha)") OR (MH "Respiration (Saba CCC)") OR (MH "Respiration Alteration (Saba CCC)")
15. (MH "Respiration+") and (MH "Muscle Strengthening")
16. TI (respirat* or inspirat* or expirat* or ventilat* or pulmonary) OR AB (respirat* or inspirat* or expirat* or ventilat* or pulmonary)
17. TI (therap* or train* or retrain* or exercise* or resist* or conditioning or strength* or weakness or endurance or muscle*) OR AB (therap* or train* or retrain* or exercise* or resist* or conditioning or strength* or weakness or endurance or muscle*)
18. S16 and S17
19. TI (breathing or inhalation or exhalation) OR AB (breathing or inhalation or exhalation)
20. TI (exercise* or therap* or train* or retrain*) OR AB (exercise* or therap* or train* or retrain*)
21. S19 and S20
22. S12 or S13 or S14 or S15 or S18 or S21

23. S11 and S22
24. PT randomized controlled trial or clinical trial
25. (MH "Random Assignment") or (MH "Random Sample+")
26. (MH "Crossover Design") or (MH "Clinical Trials+") or (MH "Comparative Studies")
27. (MH "Control (Research)") or (MH "Control Group")
28. (MH "Factorial Design") or (MH "Quasi-Experimental Studies") or (MH "Nonrandomized Trials")
29. (MH "Placebo Effect") or (MH "Placebos") or (MH "Meta Analysis")
30. (MH "Clinical Research") or (MH "Clinical Nursing Research")
31. (MH "Community Trials") or (MH "Experimental Studies") or (MH "One-Shot Case Study") or (MH "Pretest-Posttest Design+") or (MH "Solomon Four-Group Design") or (MH "Static Group Comparison") or (MH "Study Design")
32. PT systematic review
33. TI random* or AB random*
34. TI (singl* or doubl* or tripl* or trebl*) or AB (singl* or doubl* or tripl* or trebl*)
35. TI (blind* or mask*) or AB (blind* or mask*)
36. S34 and S35
37. TI (crossover or cross-over or placebo* or control* or factorial or sham) or AB (crossover or cross-over or placebo* or control* or factorial or sham)
38. TI (clin* or intervention* or compar* or experiment* or preventive or therapeutic) or AB (clin* or intervention* or compar* or experiment* or preventive or therapeutic)
39. TI trial* or AB trial*
40. S38 and S39
41. TI (counterbalance* or multiple baseline* or ABAB design) or AB (counterbalance* or multiple baseline* or ABAB design)
42. TI (meta analysis* or metaanalysis or meta-analysis or systematic review*) or AB (meta analysis* or metaanalysis or meta-analysis or systematic review*)
43. PT meta analysis
44. S24 or S25 or S26 or S27 or S28 or S29 or S30 or S31 or S32 or S33 or S34 or S35 or S36 or S37 or S38 or S39 or S40 or S41 or S42 or S43
45. S23 and S44

Excluded papers

Efficacy of interventions aiming at improving respiratory function after stroke: A systematic review.

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Studies	Reasons for exclusion			
	1	2	3	4
Almeida et al. (2011)	✓			
Aziz et al. (2008)	✓	✓		
Cuezy et al. (2010)	✓			✓
Gomes-Neto et al. (2016)	✓			
Harraf et al. (2008)	✓			
Hegland et al. (2016)	✓			
Jo et al. (2014)	✓			
Jo et al. (2016)	✓			
Jung and Kim (2015)	✓			
Kim et al. (2015)			✓	
Kulnik et al. (2014)	✓			
Martín-Valero et al. (2015)				
Meireles et al. (2012)	✓			
Menezes et al. (2016)	✓			
Menezes et al. (2017)	✓			
Narain and Puckree (2002)	✓			
Nuzzo et al. (1999)	✓			
Ocko and Costa (2014)	✓			
Ovando et al. (2010)	✓			
Park et al. (2016)				✓
Pollock et al. (2013)	✓			
Queiroz et al. (2014)	✓			
Raquel et al. (2015)	✓			
Rimmer et al. (2000)	✓			
Seo et al. (2012)	✓			
Song and Park (2015)	✓			
Veerbeek et al. (2014)	✓			
Xiao et al. (2012)	✓			
Yamashita et al. (2010)	✓			

1 = Research design not RCT

2 = Aim of experimental intervention was not to improve respiratory function

3 = Single-session intervention

4 = No outcomes of interest

Almeida ICL, Clementino ACR, Rocha EHT, Brandão DC, Andrade AD. Effects of hemiplegy on pulmonary function and diaphragmatic dome displacement. *Respir Physiol Neurobiol.* 2011; 178: 196- 201.

Aziz NA, Leonardi-Bee J, Phillips M, Gladman JR, Legg L, Walker MF (2008). Therapy-based rehabilitation services for patients living at home more than one year after stroke. *Cochrane Database Syst Rev.* 16;(2). Art No: CD005952. DOI: 10.1002/14651858.CD005952.pub2.

Cuesy PG, Sotomayor PL, Piña JO (2010). Reduction in the incidence of poststroke nosocomial pneumonia by using the "turn-mob" program. *J Stroke Cerebrovasc Dis.* 19(1): 23-28.

Gomes-Neto M, Saquetto MB, Silva CM, Carvalho VO, Ribeiro N, Conceição CS (2001). Effects of respiratory muscle training on respiratory function, respiratory muscle strength, and exercise tolerance in patients post stroke: A systematic review with meta-Analysis. *Arch Phys Med Rehabil.* 97:1994-2001.

Harraf F, Ward K, Man W, Rafferty G, Mills K, Polkey M, Moxham J, Kalra L (2008). Transcranial magnetic stimulation study of expiratory muscle weakness in acute ischemic stroke. *Neurology.* 9(24):2000-2007.

Hegland KW, Davenport PW, Brandimore AE, Singletary FF, Troche MS (2016). Rehabilitation of swallowing and cough functions following stroke: An expiratory muscle strength training trial. *Arch Phys Med Rehabil.* 97(8):1345-51.

Jo M, Kim N, Jung J (2014). The effects of respiratory muscle training on respiratory function, respiratory muscle strength, and cough capacity in stroke patients. *J Korean Soc Phys Med.* 9(4): 399-406.

Jo M-R, Kim N-S. The correlation of respiratory muscle strength and cough capacity in stroke patients (2016). *J Phys Ther Sci.* 28(10):2803-2805.

Jung J, Kim N. The effect of progressive high-intensity inspiratory muscle training and fixed high-intensity inspiratory muscle training on the asymmetry of diaphragm thickness in stroke patients. *J Phys Ther Sci.* 27(10):3267-3269.

Kim CB, Shin JH, Choi JD (2015). The effect of chest expansion resistance exercise in chronic stroke patients: a randomized controlled trial. *J Phys Ther Sci.* 27(2):451-453.

Kulnik ST, Rafferty GF, Birring SS, Moxham J, Kalra L (2014). A pilot study of respiratory muscle training to improve cough effectiveness and reduce the incidence of pneumonia in acute stroke: study protocol for a randomized controlled trial. *Trials.* 12;15:123.

Martín-Valero R, De La Casa Almeida M, Casuso-Holgado MJ, Heredia-Madrado A (2015). Systematic Review of Inspiratory Muscle Training After Cerebrovascular Accident. *Respir Care.* 60(11):1652-9.

Meireles ALF, Meireles LCF, Queiroz JCES, Tassitano RM, Soares FO, Oliveira AS (2012). Effectiveness of electrical stimulation in expiratory muscle on cough of patients after stroke. *Fisioter Pesqui.* 19(4):314-319.

Menezes KKP, Nascimento LR, Ada L, Polese JC, Avelino PR, Teixeira-Salmela LF (2016). Respiratory muscle training increases respiratory muscle strength and reduces respiratory complications after stroke: a systematic review. *J Physiother.* 62: 138-144.

Menezes KKP, Nascimento LR, Polese JC, Ada L, Teixeira-Salmela LF (2017). Effect of high-intensity home-based respiratory muscle training on strength of 1 respiratory muscles after stroke: A protocol for a randomised controlled trial. *Braz J Phys Ther. Ahead of print*

- Narain S, Puckree T (2002). Pulmonary function in hemiplegia. *Int J Rehabil Res.* 25(1):57-59.
- Nuzzo NA; Bronson LA, McCarthy T, Massery M (1999). Respiratory muscle strength and endurance following a CVA. *J Neuro Phys Ther.* 23(1):25-27.
- Ocko R, Costa MC (2014). Respiratory Changes in Patients with Stroke. *Biomed Biopharm Res.* (11)2:141-150.
- Ovando AC, Michaelsen SM, Dias JA, Herber V (2010). Gait training, cardiorespiratory training and strength training after stroke: strategies, dose and outcomes. *Fisioter mov.* 23(2):253-269.
- Park JS, Oh DH, Chang MY, Kim KM (2016). Effects of expiratory muscle strength training on oropharyngeal dysphagia in subacute stroke patients: a randomised controlled trial. *J Oral Rehabil.* 43(5):364-72.
- Pollock RD, Rafferty GF, Moxham J, Kalra L (2013). Respiratory muscle strength and training in stroke and neurology: a systematic review. *Int J Stroke.* 8(2):124-130.
- Queiroz AGC, Silva DD, Lira RAC, Bassini SRF, Uematsu ESC. Respiratory muscle training associated with electrical stimulation diaphragmatic in hemiparesis. *Rev Neurocienc.* 22(2):294-299.
- Raquel DFS, Quitério RJ, Campos MF, Vieira S, Ambrozini ARP (2015). Effects of the resisted exercise in the respiratory function of individuals with hemiparesis after stroke. *Pulm Res Respir Med Open J.* 2(2): 84-89.
- Rimmer JH, Riley B, Creviston T, Nicola T (2000). Exercise training in a predominantly African-American group of stroke survivors. *Med Sci Sports Exerc.* 32(12):1990-1996.
- Seo KC, Kim Ha, Lim SW (2012). Effects of feedback respiratory exercise and diaphragm respiratory exercise on the pulmonary function of chronic stroke patients. *J Int Acad Phys Ther Res.* 3(2): 413-478.
- Song G bin, Park E cho (2015). Effects of chest resistance exercise and chest expansion exercise on stroke patients' respiratory function and trunk control ability. *J Phys Ther Scie.* 27(6):1655-1658.
- Veerbeek JM, Wegen E, Peppen R, Wees PJ, Hendriks E, Rietberg M, Kwakkel G (2014). What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. *PLoS One.* 9(2):1-33.
- Xiao Y, Luo M, Wang J, Luo H (2012). Inspiratory muscle training for the recovery of function after stroke. *Cochrane Database Syst Rev.* 16:5. Art No:CD009360. DOI: 10.1002/14651858.CD009360.pub2.
- Yamashita K, Kikuchi N, Ito K (2010). Effects of expiratory muscle training on respiratory muscle strength and cough intensity of stroke patients. *Rigakuryoho Kagaku.* 25(6):849-853.