



EVIDENCE SEARCH RESULTS

Question/subject of request:	Recent evidence using EMST (Expiratory muscle strength training) in the stroke population (acute or community) and outcomes for dysphagia and communication management
Date requested:	28 th June 2024
Date completed:	18 th July 2024
Compiled by:	Cate Newell – Knowledge & Library Service Manager

CITING THIS SEARCH

If you reference this search in any paper, publication or presentation, please let us know.

The citation format is:

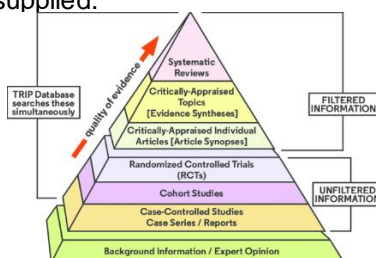
- Newell, C., (2024). *Expiratory muscle strength training – stroke & dysphagia*, Taunton, UK: Somerset Foundation Trust Knowledge and Library Services.

CONTACT DETAILS

Knowledge & Library Services:	<p>Email: library@somersetft.nhs.uk</p> <p>Telephone: MPH (01823) 342433 or YDH (01935) 384495 / 4697</p> <p>Website: https://somersetft-nhs.libguides.com/home</p> <p>Twitter: @SOMNHS_KLS</p>
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The results are presented according to the hierarchy of evidence which is used to rank the relative strength of results obtained from scientific research.

The design of the study and the endpoints measured affect the strength of the evidence.

Evidence hierarchies are often applied in evidence-based practices and are integral to evidence-based medicine.



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Contents (click to jump to each section):

- [UpToDate](#)
- [Systematic reviews and meta-analysis](#)
- [Randomised controlled trials](#)
- [Journal articles](#)

Summary of search results:

The Royal College of Speech and Language Therapists and the NIHR have expiratory muscle strengthening on their top ten list of [research priorities for dysphagia](#):

8. Can expiratory muscle strengthening (training exercises to increase the strength of respiratory muscles for improving cough and swallow functions) reduce chest infections in (a) head and neck cancer and (b) stroke patients with dysphagia?

The evidence search results include a number of systematic reviews and meta-analyses which have recently been published.

I hope this is helpful. Please do let us know if you need any further information.

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Thank you.

UpToDate

Tests of respiratory muscle strength - UpToDate

Item Type: Web Page

Authors: Rafferty, G.F.

Publication Year: 2024

URL: <https://www.uptodate.com/contents/tests-of-respiratory-muscle-strength>

Date Retrieved: Jul 11, 2024

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Systematic reviews & meta-analysis

1. The Effect of Respiratory Muscle Training on Swallowing Function in Patients With Stroke: A Systematic Review and Meta-Analysis

Authors: Hao, Xiaonan;Yang, Yuhang;Qin, Yuan;Lv, Miaohua;Zhao, Xuetong;Wu, Shuang and Li, Kun

Publication Date: 2024

Journal: Western Journal of Nursing Research 46(5), pp. 389-399

Abstract: **BACKGROUND:** The improvement of swallowing function after stroke is a significant challenge faced by patients and health care professionals. However, the current evidence synthesis of the effects of respiratory muscle training (RMT) on swallowing function is limited. **OBJECTIVE:** To assess the effectiveness of RMT on swallowing recovery in patients undergoing stroke. **METHODS:** The CKNI, WanFang Data, PubMed, CINAHL, Web of Science, Embase, MEDLINE, and Cochrane Library databases were searched for studies evaluating RMT interventions' effect on swallowing outcomes. Risks of bias were evaluated using the approach recommended by the Cochrane Collaboration tool and a summary of findings table was generated using the GRADE approach. Outcomes were synthesized using a random-effects meta-analysis model. **RESULTS:** RMT interventions reduced the risk of aspiration (SMD = 1.19; 95% CI, 0.53-1.84), the recovery process of water swallowing function (RR = 1.22; 95% CI, 1.05-1.42), and the activity of the swallowing muscles (SMD = 2.91; 95% CI, 2.22-3.61). However, there was no significant effect of RMT on the functional level of oral intake (SMD = 0.70; 95% CI, -0.03 to 1.42). **CONCLUSIONS:** RMT can be regarded as an innovative, auxiliary means in the near future to better manage and improve swallowing function, given its improving effect on work outcomes in this review.

Access or request full text: <https://libkey.io/10.1177/01939459241242533>

2. "Effects of threshold respiratory muscle training on respiratory muscle strength, pulmonary function and exercise endurance after stroke: a meta-analysis"

Item Type: Journal Article

Authors: Li L,Liu R,He J,Li J.

Publication Date: /4 ,2024

Journal: Journal of Stroke and Cerebrovascular Diseases : The Official Journal of National Stroke Association , pp. 107837

Abstract: "Effects of threshold respiratory muscle training on respiratory muscle strength, pulmonary function and exercise endurance after stroke: a meta-analysis". Most studies on improvements in respiratory muscle strength, activities of daily living (ADL) and quality of life (QoL) in stroke patients receiving threshold respiratory muscle training (TRMT) have small sample sizes, and some studies have contradictory results. To evaluate the effectiveness of TRMT on respiratory muscle strength, pulmonary function and exercise endurance in stroke patients. PubMed, Cochrane Library, Physical Therapy Evidence Database (PEDro), Embase (via OVID) and Web of Science databases were searched for



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randomized controlled trial (RCT) from inception to January 17, 2024. The primary outcome was maximum inspiratory pressure (MIP) or maximum expiratory pressure (MEP). Secondary outcomes included pulmonary function measured by forced vital capacity (FVC), forced expiratory volume in 1 second (FEV) and peak expiratory flow (PEF), and exercise endurance measured by 6-minute walk test (6MWT). A total of eight randomized controlled trials (RCTs), including 305 persons, were included in this study. The training time ranged from 3 weeks to 10 weeks. Among them, the intervention group in 4 studies used inspiratory muscle training, and the other 4 studies used inspiratory muscle training and expiratory muscle training. For the primary outcome, TRMT significantly improved MIP (mean=14.68 cmHO, 95%CI=2.28 to 27.09 cmHO, P=0.02) and MEP (mean=9.37 cmHO, 95%CI=2.89 to 15.84 cmHO, P=0.005) in stroke patients. Regarding the secondary outcomes, TRMT improved FVC, FEV1 and 6MWT (P<0.05) but did not significantly improve PEF. TRMT improved inspiratory muscle strength and expiratory muscle strength, improved exercise endurance, and improved FVC and FEV1 of pulmonary function but did not significantly improve PEF.

Access or request full text: <https://libkey.io/10.1016/j.jstrokecerebrovasdis.2024.107837>

3. Implications for respiratory muscle training in patients with stroke-associated pneumonia: a meta-analysis.

Authors: Wu, Ming; Mo, Ming-Yu; Huang, Xiao-Dan and Wei, Jing

Publication Date: Feb 08, 2024

Journal: Disability & Rehabilitation 1-7

Abstract: PURPOSE: To evaluate the effect of respiratory muscle training on improving lung function in patients with stroke-associated pneumonia. MATERIALS AND METHODS: A systematic retrieval was conducted using the databases of the Cochrane Library, PubMed, the Web of Science, Embase, ProQuest, and others. Studies involving patients who received respiratory muscle training with/without a breathing trainer and those who adopted routine post-stroke rehabilitation training were included in the systematic review. The statistical analysis was performed using RevMan 5.3 software. RESULTS: Fourteen studies were included involving 850 patients with stroke. According to the results of the meta-analysis, compared with the control group, there were statistically significant differences in forced vital capacity (FVC) measurements (mean difference (MD) = 0.93, p CONCLUSIONS: The implementation of respiratory muscle training can improve FVC and FEV lung function indicators, inspiratory muscle strength and the 6-min walk test results in patients with stroke.; plain-language-summary Respiratory training-based pulmonary rehabilitation training can improve lung function and activity tolerance of stroke patients. Pulmonary rehabilitation training is more effective than standard rehabilitation training in enhancing PI_{max} for stroke patients. Patients receiving pulmonary rehabilitation training have better activity tolerance after intervention. Language: English

Access or request full text: <https://libkey.io/10.1080/09638288.2024.2314159>



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4. The effects of respiratory muscle training on respiratory function and functional capacity in patients with early stroke: a meta-analysis

Authors: Zhang Y,Zhang K,Huang L,Wei J,Bi Z,Xiao J,Huang J,Luo C,Li Y,Zhang J.

Publication Date: /0 ,2024

Journal: European Review of Aging and Physical Activity : Official Journal of the European Group for Research into Elderly and Physical Activity 21, pp. 4

Abstract: The effects of respiratory muscle training on respiratory function and functional capacity in patients with early stroke: a meta-analysis. Respiratory muscle training is a continuous and standardized training of respiratory muscles, but the evidence of the effects on early stroke patients is not clear. This meta-analysis aimed to investigate the effects of respiratory muscle training on respiratory function and functional capacity in patients with early stroke. PubMed, Embase, PEDro, ScienceDirect, AMED, CINAHL, and China National Knowledge Infrastructure databases were searched from inception to December 8, 2023 for articles about studies that 1) stroke patients with age \geq 18 years old. Early stroke < 3 months at the time of diagnosis, 2) respiratory muscle training, including inspiratory and expiratory muscle training, 3) the following measurements are the outcomes: respiratory muscle strength, respiratory muscle endurance, pulmonary function testing, dyspnea fatigue score, and functional capacity, 4) randomized controlled trials. Studies that met the inclusion criteria were extracted data and appraised the methodological quality and risk of bias using the Physiotherapy Evidence Database scale and the Cochrane Risk of Bias tool by two independent reviewers. RevMan 5.4 with a random effect model was used for data synthesis and analysis. Mean differences (MD) or standard mean differences (SMD), and 95% confidence interval were calculated (95%CI). Nine studies met inclusion criteria, recruiting 526 participants (mean age 61.6 years). Respiratory muscle training produced a statistically significant effect on improving maximal inspiratory pressure (MD = 10.93, 95%CI: 8.51-13.36), maximal expiratory pressure (MD = 9.01, 95%CI: 5.34-12.69), forced vital capacity (MD = 0.82, 95%CI: 0.54-1.10), peak expiratory flow (MD = 1.28, 95%CI: 0.94-1.63), forced expiratory volume in 1 s (MD = 1.36, 95%CI: 1.13-1.59), functional capacity (SMD = 0.51, 95%CI: 0.05-0.98) in patients with early stroke. Subgroup analysis showed that inspiratory muscle training combined with expiratory muscle training was beneficial to the recovery of maximal inspiratory pressure (MD = 9.78, 95%CI: 5.96-13.60), maximal expiratory pressure (MD = 11.62, 95%CI: 3.80-19.43), forced vital capacity (MD = 0.87, 95%CI: 0.47-1.27), peak expiratory flow (MD = 1.51, 95%CI: 1.22-1.80), forced expiratory volume in 1 s (MD = 0.76, 95%CI: 0.41-1.11), functional capacity (SMD = 0.61, 95%CI: 0.08-1.13), while inspiratory muscle training could improve maximal inspiratory pressure (MD = 11.60, 95%CI: 8.15-15.05), maximal expiratory pressure (MD = 7.06, 95%CI: 3.50-10.62), forced vital capacity (MD = 0.71, 95%CI: 0.21-1.21), peak expiratory flow (MD = 0.84, 95%CI: 0.37-1.31), forced expiratory volume in 1 s (MD = 0.40, 95%CI: 0.08-0.72). This study provides good-quality evidence that respiratory muscle training is effective in improving respiratory muscle strength, pulmonary function, and functional capacity for patients with early stroke. Inspiratory muscle training combined with expiratory muscle training seems to promote functional recovery in patients with early stroke more than inspiratory muscle training alone. Prospero registration number: CRD42021291918.

Access or request full text: <https://libkey.io/10.1186/s11556-024-00338-7>

5. Relationship between trunk control ability and respiratory function in stroke patients: A scoping review and meta-analysis



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Authors: Pai H, Li C.

Publication Date: /2 ,2023

Journal: Asian Nursing Research

Abstract: Relationship between trunk control ability and respiratory function in stroke patients: A scoping review and meta-analysis. Hemiparesis in stroke survivors has been reported to affect respiratory function. The relationship between trunk control and respiratory function, however, is not well understood. We aimed to map the state of the association between the trunk and respiratory function as well as evaluate the effect of a respiratory function training intervention on trunk control for stroke survivors. A scoping review and meta-analysis of observational and interventional studies were performed. Cochrane Library, CINAHL with Full Text (EBSCO), Medline (Ovid), and PubMed were searched using the terms stroke, respiratory, and trunk control. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist was used to examine the sections of each report. A total of 102 studies were identified, of which 12, published between 2011 and 2022, were included in the meta-analysis or narrative synthesis. Three studies were included in the meta-analysis of the correlation between trunk control and respiratory function parameters (forced vital capacity FVC], forced expiratory volume during the first breath FEV], maximal inspiratory pressure MIP], and maximal expiratory pressure MEP]) with effect sizes (Fisher's z) for all outcomes, which ranged from small to intermediate (between 0.21 and 0.39). Furthermore, five studies were included in the meta-analysis of the effect of respiratory function training intervention on trunk control. An overall effect size (Cohen's d) of 1.47 corresponds to a large effect. We also found significant improvements in MIP and MEP, but not in FVC and FEV for stroke survivors with the interventions. Respiratory training, use of diaphragmatic resistance exercise or abdominal breathing, use of a pressure threshold-loading device, and the performance of functional strengthening exercises for the trunk muscles, were found to increase patients' trunk control and improve their respiratory muscle strength.

Access or request full text: <https://libkey.io/10.1016/j.anr.2023.04.001>

6. Dosages of swallowing exercises in stroke rehabilitation: a systematic review

Publication Date: /11 ,2022

Journal: European Archives of Oto-Rhino-Laryngology

Access or request full text: <https://libkey.io/10.1007/s00405-022-07735-7>

7. Effectiveness of Respiratory Muscle Training on Respiratory Muscle Strength, Pulmonary Function, and Respiratory Complications in Stroke Survivors: A Systematic Review of Randomized Controlled Trials

Authors: Deme, Sisay;Lamba, Dheeraj;Alamer, Abayneh;Melese, Haimanot;Ayhuallem, Sileshi;Imeru, Dechassa and Abebe, Tsegereda

Publication Date: 2022

Journal: Degenerative Neurological & Neuromuscular Disease 12, pp. 75-84

Abstract: Background: Stroke is the most common leading cause of mortality and related



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morbidity worldwide. After stroke, the motor function of extremities and spinal muscles is significantly impaired, but not only this, it also has attributable factors leading to respiratory dysfunction. Nevertheless, to the extent of the authors' knowledge, there is a dearth of conclusive studies which examined the effectiveness of RMT on muscle strength, pulmonary function, and respiratory complications of individuals after stroke. **Objective:** The purpose of this systematic review was to evaluate the effectiveness of respiratory muscle training on respiratory muscle strength, pulmonary function, and respiratory complications in patients after stroke. **Methods:** An electronic database search of HINARI, PEDro, PubMed, Cochrane Library and Google scholar was used to identify randomized controlled trials that evaluated the effectiveness of respiratory muscle training in patients with stroke. Articles published from 2010 to 2019 were included. The quality of the articles was assessed using PEDro scale. Articles with abstract only, PEDro scores less than 5, published in non-English language, not freely available articles, and quasi experimental studies were excluded from this study. **Results:** The literature search yielded a total of 7 articles (6 randomized controlled trials with 1 pilot randomized controlled trial) which met inclusion criteria despite their heterogeneity. The methodological quality of all studies ranged from 6 to 8 in Pedro score. Most of the articles reported a significant increase in respiratory muscle strength, respiratory muscle function, and reduced risk of complications with a p value : The literature search yielded a total of 7 articles (6 randomized controlled trials with 1 pilot randomized controlled trial) which met inclusion criteria despite their heterogeneity. The methodological quality of all studies ranged from 6 to 8 in Pedro score. Most of the articles reported a significant increase in respiratory muscle strength, respiratory muscle function, and reduced risk of complications with a p value **Conclusion:** Respiratory muscle training could potentially improve muscle strength and pulmonary functions of subjects after stroke. Thus, it may reduce stroke-related respiratory complications in subjects after stroke. However, further study is warranted with high quality RCTs and pooled synthesis of results. Copyright © 2022 Deme et al.

Access or request full text: <https://libkey.io/10.2147/DNND.S348736>

8. Respiratory Muscle Training Reduces Respiratory Complications and Improves Swallowing Function After Stroke: A Systematic Review and Meta-Analysis

Authors: Zhang, Weisong;Pan, Huijuan;Zong, Ya;Wang, Jixian and Xie, Qing

Publication Date: 2022

Journal: Archives of Physical Medicine & Rehabilitation 103(6), pp. 1179-1191

Abstract: **OBJECTIVE:** To investigate whether respiratory muscle training is capable of reducing the occurrence of respiratory complications and improving dysphagia (swallowing or cough function) after stroke. **DATA SOURCES:** Cochrane Library, Excerpta Medical Database (EMBASE), PUBMED, and Web of Science were searched for studies published in English; the China Biology Medicine (CBM), China Science and Technology Journal Database (VIP), China National Knowledge Infrastructure (CNKI), and Wanfang Database were searched for studies published in Chinese up to August 10, 2021. **STUDY SELECTION:** Eleven randomized control trials (RCTs) (N=523) met the inclusion criteria were included in this systematic review. **DATA EXTRACTION:** Data and information were extracted by two reviewers independently and disagreements was resolved by consensus with a third coauthor. Primary outcome was the occurrence of respiratory complications, secondary outcomes would be represented by swallowing and cough function. The quality of each included RCT were assessed by Cochrane risk-of-bias criteria and the GRADE evidence profile was provided to present information about the body of evidence and judgments



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about the certainty of underlying evidence for each outcome. **DATA SYNTHESIS:** Respiratory muscle training reduced the risk of respiratory complications (relative risk, 0.51; 95% confidence interval [CI], 0.28-0.93; $I^2=0\%$; $P=.03$; absolute risk difference, 0.068; number need to treat, 14.71) compared with no or sham respiratory intervention. It also decreased the liquid-type Penetration-Aspiration Scale scores by 0.81 (95% CI, -1.19 to -0.43; $I^2=39\%$; $P=39\%$; $P^2=55\%$; $P=.32$), decreased peak expiratory cough flow of voluntary cough by 18.70 L per minute (95% CI, -59.74 to 22.33; $I^2=19\%$; $P=.37$) and increased peak expiratory cough flow of reflex cough by 0.05 L per minute (95% CI, -40.78 to 40.87; $I^2=0\%$; $P>.99$). **CONCLUSION:** This meta-analysis provided evidence that respiratory muscle training is effective in reducing the risk of respiratory complications and improving dysphagia by reducing penetration or aspiration during swallowing liquid bolus after stroke. However, there was no sufficient evidence to determine that respiratory muscle training improves cough function. Additional multicenter studies using larger patient cohorts are required to validate and support these findings. Furthermore, long-term follow-up studies should be performed to measure outcomes, while avoiding bias due to confounding factors such as heterogeneity of the etiologies of dysphagia. Copyright © 2021 The Authors. Published by Elsevier Inc. All rights reserved.

Access or request full text: <https://libkey.io/10.1016/j.apmr.2021.10.020>

9. Respiratory muscle training improves exercise tolerance and respiratory muscle function/structure post-stroke at short term: A systematic review and meta-analysis

Authors: Fabero-Garrido R, Corral TD, Angulo-Díaz-Parreño S, Plaza-Manzano G, Martín-Casas P, Cleland JA, Fernández-de-Las-Peñas C, López-de-Uralde-Villanueva I.

Publication Date: /10, 2021

Journal: Annals of Physical and Rehabilitation Medicine 65, pp. 101596

Abstract: Respiratory muscle training improves exercise tolerance and respiratory muscle function/structure post-stroke at short term: A systematic review and meta-analysis. Previous reviews relating to the effects of respiratory muscle training (RMT) after stroke tend to focus on only one type of training (inspiratory or expiratory muscles) and most based the results on poor-quality studies (PEDro score ≤ 4). With this systematic review and meta-analysis, we aimed to determine the effects of RMT (inspiratory or expiratory muscle training, or mixed) on exercise tolerance, respiratory muscle function and pulmonary function and also the effects depending on the type of training performed at short- and medium-term in post-stroke. Databases searched were MEDLINE, PEDro, CINAHL, EMBASE and Web of Science up to the end of April 2020. The quality and risk of bias for each included study was examined by the PEDro scale (including only high-quality studies) and Cochrane Risk of Bias tool. Nine studies (463 patients) were included. The meta-analysis showed a significant increase in exercise tolerance 4 studies; $n = 111$; standardized mean difference [SMD] = 0.65 (95% confidence interval 0.27-1.04)]; inspiratory muscle strength 9 studies; $n = 344$; SMD = 0.65 (0.17-1.13)]; inspiratory muscle endurance 3 studies; $n = 81$; SMD = 1.19 (0.71-1.66)]; diaphragm thickness 3 studies; $n = 79$; SMD = 0.9 (0.43-1.37)]; and peak expiratory flow 3 studies; $n = 84$; SMD = 0.55 (0.03-1.08)] in the short-term. There were no benefits on expiratory muscle strength and pulmonary function variables (forced expiratory volume in 1 s) in the short-term. The meta-analysis provided moderate-quality evidence that RMT improves exercise tolerance, diaphragm thickness and pulmonary function (i.e., peak expiratory flow) and low-quality evidence for the effects on inspiratory muscle strength and endurance in stroke survivors in the short-term. None of these effects are retained in the medium-term. Combined inspiratory and expiratory muscle training



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seems to promote greater respiratory changes than inspiratory muscle training alone.

Access or request full text: <https://libkey.io/10.1016/j.rehab.2021.101596>

10. Effectiveness of Respiratory Muscle Training for Pulmonary Function and Walking Ability in Patients with Stroke: A Systematic Review with Meta-Analysis

Authors: Pozuelo-Carrascosa DP, Carmona-Torres JM, Laredo-Aguilera JA, Latorre-Román PÁ, Párraga-Montilla JA, Cobo-Cuenca AI.

Publication Date: /11 ,2020

Journal: International Journal of Environmental Research and Public Health 17

Abstract: Effectiveness of Respiratory Muscle Training for Pulmonary Function and Walking Ability in Patients with Stroke: A Systematic Review with Meta-Analysis. : Neurological dysfunction due to stroke affects not only the extremities and trunk muscles but also the respiratory muscles. : to synthesise the evidence available about the effectiveness of respiratory muscle training (RMT) to improve respiratory function parameters and functional capacity in poststroke patients. : a systematic electronic search was performed in the MEDLINE, EMBASE, SPORTDiscus, PEDro and Web of Science databases, from inception to May 2020. : randomised controlled trials (RCTs) that examined the effects of RMT versus non-RMT or sham RMT in poststroke patients. We extracted data about respiratory function, respiratory muscle strength and functional capacity (walking ability, dyspnea, balance, activities of daily life), characteristics of studies and features of RMT interventions (a type of RMT exercise, frequency, intensity and duration). Two reviewers performed study selection and data extraction independently. : nineteen RCTs met the study criteria. RMT improved the first second forced expiratory volume (FEV1), forced vital capacity (FVC), peak expiratory flow (PEF), maximal expiratory pressure (MEP), maximal inspiratory pressure (MIP) and walking ability (6 min walking test), but not Barthel index, Berg balance scale, and dyspnea. : RMT interventions are effective to improve respiratory function and walking ability in poststroke patients.

Access or request full text: <https://libkey.io/10.3390/ijerph17155356>

11. Respiratory Muscle Training Improves Strength and Decreases the Risk of Respiratory Complications in Stroke Survivors: A Systematic Review and Meta-analysis

Authors: Wu F, Liu Y, Ye G, Zhang Y.

Publication Date: /0 ,2020

Journal: EvidenceUpdates 101, pp. 1991-2001

Abstract: Respiratory Muscle Training Improves Strength and Decreases the Risk of Respiratory Complications in Stroke Survivors: A Systematic Review and Meta-analysis To evaluate the effects of respiratory muscle training in a population of stroke patients. The following databases were searched for clinical trials through December 2019: PubMed, EMBASE, Cochrane Library, CINAHL, and China National Knowledge Infrastructure. Randomized controlled trials (N=9) published in English met the inclusion criteria. Data were extracted and assessed for accuracy by 2 reviewers. Any disagreements were resolved after discussions with an independent third reviewer. The quality of the included randomized controlled trials was assessed using the Cochrane bias tool. The meta-analysis showed



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increased maximal inspiratory pressure (standardized mean difference SMD], 0.88; 95% confidence interval CI], 0.62-1.15; P<.001; 12-wk follow-up period: SMD, 0.94; 95% CI, 0.42-1.45; P<.001), maximal expiratory pressure (SMD, 0.83; 95% CI, 0.15-1.52; P=.017; 12-wk follow-up period: SMD, 0.99; 95% CI, 0.47-1.51; P<.001), forced expiratory volume in 1 second (SMD, 1.41; 95% CI, 0.57-2.24; P=.001), forced vital capacity (SMD, 1.36; 95% CI, 0.55-2.16; P<.001), peak expiratory flow (SMD, 0.74; 95% CI, 0.16-1.32; P=.013), 6-minute walk test (SMD, 0.67; 95% CI, 0.11-1.23; P=.020), and decreased respiratory complications (odds ratio, 0.55; 95% CI, 0.30-1.00; P=.050) compared with no respiratory intervention or a sham intervention. Respiratory muscle training improved poststroke muscle strength and the benefits were carried over for up to 12 weeks, including improved lung function, walking capacity, and a reduced risk of respiratory impediments.

Access or request full text: <https://libkey.io/10.1016/j.apmr.2020.04.017>

12. Effect of Expiratory Muscle Strength Training on Swallowing and Cough Functions in Patients With Neurological Diseases: A Meta-analysis

Authors: Wang, Zhuo;Wang, Zhi;Fang, Qi;Li, Huiling;Zhang, Lulu and Liu, Xueyun

Publication Date: /12// ,2019

Journal: American Journal of Physical Medicine & Rehabilitation 98(12), pp. 1060-1066

Abstract: Supplemental digital content is available in the text. Objective: The aim of this review was to evaluate and summarize the results of published studies exploring the effects of expiratory muscle strength training on swallowing and cough functions in patients with neurological diseases. Data Sources: The study used Embase, PubMed, and the Cochrane Library as data sources. Review Methods: Randomized controlled trials or pretest/posttest studies of adults with neurological diseases were included. The data included basic population characteristics, penetration-aspiration scores, peak expiratory flow rate, cough volume acceleration, and maximum expiratory pressure. Results: Ten studies were included in this meta-analysis. Compared with the control groups, expiratory muscle strength training in patients with neurological diseases significantly reduced the penetration-aspiration scores (risk ratio = -0.94, 95% confidence interval = 1.27 to -0.61, P < 0.01) but did not increase the voluntary cough peak expiratory flow rate (risk ratio = 0.57, 95% confidence interval = 0.62 to 1.77, P = 0.35), cough volume acceleration (risk ratio = 33.87, 95% confidence interval = 57.11 to 124.85, P = 0.47), or maximum expiratory pressure (risk ratio = 14.78, 95% confidence interval = 16.98 to 46.54, P = 0.36). Conclusions: Expiratory muscle strength training might improve swallowing function in patients with neurological diseases. However, conclusive evidence supporting the use of this approach in isolation for improving cough function is unavailable. Additional multicenter, randomized clinical trials performed using reliable and valid cough function outcome measures are required to explore the effects of expiratory muscle strength training on cough function.

Access or request full text: <https://libkey.io/10.1097/PHM.0000000000001242>

13. Respiratory muscle training increases respiratory muscle strength and reduces respiratory complications after stroke: a systematic review

Authors: Menezes KK,Nascimento LR,Ada L,Polese JC,Avelino PR,Teixeira-Salmela LF.



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Publication Date: /5 ,2016

Journal: Journal of Physiotherapy 62, pp. 138-144

Abstract: Respiratory muscle training increases respiratory muscle strength and reduces respiratory complications after stroke: a systematic review. After stroke, does respiratory muscle training increase respiratory muscle strength and/or endurance? Are any benefits carried over to activity and/or participation? Does it reduce respiratory complications? Systematic review of randomised or quasi-randomised trials. Adults with respiratory muscle weakness following stroke. Respiratory muscle training aimed at increasing inspiratory and/or expiratory muscle strength. Five outcomes were of interest: respiratory muscle strength, respiratory muscle endurance, activity, participation and respiratory complications. Five trials involving 263 participants were included. The mean PEDro score was 6.4 (range 3 to 8), showing moderate methodological quality. Random-effects meta-analyses showed that respiratory muscle training increased maximal inspiratory pressure by 7 cmH₂O (95% CI 1 to 14) and maximal expiratory pressure by 13 cmH₂O (95% CI 1 to 25); it also decreased the risk of respiratory complications (RR 0.38, 95% CI 0.15 to 0.96) compared with no/sham respiratory intervention. Whether these effects carry over to activity and participation remains uncertain. This systematic review provided evidence that respiratory muscle training is effective after stroke. Meta-analyses based on five trials indicated that 30minutes of respiratory muscle training, five times per week, for 5 weeks can be expected to increase respiratory muscle strength in very weak individuals after stroke. In addition, respiratory muscle training is expected to reduce the risk of respiratory complications after stroke. Further studies are warranted to investigate whether the benefits are carried over to activity and participation. PROSPERO (CRD42015020683). 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. Journal of Physiotherapy 62: 138-144].

Access or request full text: <https://libkey.io/10.1016/j.jphys.2016.05.014>

14. Respiratory muscle strength and training in stroke and neurology: a systematic review

Authors: Pollock RD, Rafferty GF, Moxham J, Kalra L.

Publication Date: /0 ,2013

Journal: International Journal of Stroke : Official Journal of the International Stroke Society 8, pp. 124-130

Abstract: Respiratory muscle strength and training in stroke and neurology: a systematic review. We undertook two systematic reviews to determine the levels of respiratory muscle weakness and effects of respiratory muscle training in stroke patients. Two systematic reviews were conducted in June 2011 using a number of electronic databases. Review 1 compared respiratory muscle strength in stroke and healthy controls. Review 2 was expanded to include randomized controlled trials assessing the effects of respiratory muscle training on stroke and other neurological conditions. The primary outcomes of interest were maximum inspiratory and expiratory mouth pressure (maximum inspiratory pressure and maximum expiratory pressure, respectively). Meta-analysis of four studies revealed that the maximum inspiratory pressure and maximum expiratory pressure were significantly lower ($P < 0.00001$) in stroke patients compared with healthy individuals (weighted mean difference -41.39 and -54.62 cmH₂O, respectively). Nine randomized controlled trials indicate a significantly ($P = 0.0009$) greater effect of respiratory muscle



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training on maximum inspiratory pressure in neurological patients compared with control subjects (weighted mean difference 6.94 cmH₂O) while no effect on maximum expiratory pressure. Respiratory muscle strength appears to be impaired after stroke, possibly contributing to increased incidence of chest infection. Respiratory muscle training can improve inspiratory but not expiratory muscle strength in neurological conditions, although the paucity of studies in the area and considerable variability between them is a limiting factor. Respiratory muscle training may improve respiratory muscle function in neurological conditions, but its clinical benefit remains unknown.

Access or request full text: <https://libkey.io/10.1111/j.1747-4949.2012.00811.x>

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Randomised controlled trials

1. Effects of expiratory muscle strength training (EMST) on oropharyngeal dysphagia in subacute stroke patients: A randomised controlled trial

Authors: Erfmann, Kerstin

Publication Date: /06// ,2017

Journal: Journal of Clinical Practice in Speech-Language Pathology 19(2), pp. 111

URL: <https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=cin20&AN=124426256&profile=ehost>

2. Respiratory muscle strength training and neuromuscular electrical stimulation in subacute dysphagic stroke patients: a randomized controlled trial

Authors: Guillén-Solà, Anna;Messagi Sartor, Monique;Bofill Soler, Neus;Duarte, Esther;Barrera, M^a C. and Marco, Ester

Publication Date: /06// ,2017

Journal: Clinical Rehabilitation 31(6), pp. 761-771

Abstract: Objective: To evaluate the effectiveness of inspiratory/expiratory muscle training (IEMT) and neuromuscular electrical stimulation (NMES) to improve dysphagia in stroke. Design: Prospective, single-blind, randomized-controlled trial. Setting: Tertiary public hospital. Subjects: Sixty-two patients with dysphagia were randomly assigned to standard swallow therapy (SST) (Group I, controls, n=21), SST+ IEMT (Group II, n=21) or SST+ sham IEMT+ NMES (Group III, n=20). Interventions: All patients followed a 3-week standard multidisciplinary rehabilitation program of SST and speech therapy. The SST+IEMT group's muscle training consisted of 5 sets/10 repetitions, twice-daily, 5 days/week. Group III's sham IEMT required no effort; NMES consisted of 40-minute sessions, 5 days/week, at 80Hz. Main outcomes: Dysphagia severity, assessed by Penetration-Aspiration Scale, and respiratory muscle strength (maximal inspiratory and expiratory pressures) at the end of intervention and 3-month follow-up. Results: Maximal respiratory pressures were most improved in Group II: treatment effect was 12.9 (95% confidence interval 4.5-21.2) and 19.3 (95% confidence interval 8.5-30.3) for maximal inspiratory and expiratory pressures,



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respectively. Swallowing security signs were improved in Groups II and III at the end of intervention. No differences in Penetration-Aspiration Scale or respiratory complications were detected between the 3 groups at 3-month follow-up. Conclusion: Adding IEMT to SST was an effective, feasible, and safe approach that improved respiratory muscle strength. Both IEMT and NMES were associated with improvement in pharyngeal swallowing security signs at the end of the intervention, but the effect did not persist at 3-month follow-up and no differences in respiratory complications were detected between treatment groups and controls.

Access or request full text: <https://libkey.io/10.1177/0269215516652446>

3. Rehabilitation of Swallowing and Cough Functions Following Stroke: An Expiratory Muscle Strength Training Trial.

Authors: Hegland, Karen Wheeler; Davenport, Paul W.; Brandimore, Alexandra E.; Singletary, Floris F. and Troche, Michelle S.

Publication Date: 2016

Journal: Archives of Physical Medicine & Rehabilitation 97(8), pp. 1345-1351

Abstract: **OBJECTIVE:** To determine the effect of expiratory muscle strength training (EMST) on both cough and swallow function in stroke patients. **DESIGN:** Prospective pre-post intervention trial with 1 participant group. **SETTING:** Two outpatient rehabilitation clinics. **PARTICIPANTS:** Adults (N=14) with a history of ischemic stroke in the preceding 3 to 24 months. **INTERVENTION:** EMST. The training program was completed at home and consisted of 25 repetitions per day, 5 days per week, for 5 weeks. **MAIN OUTCOME MEASURES:** Baseline and posttraining measures were maximum expiratory pressure, voluntary cough airflows, reflex cough challenge to 200µmol/L of capsaicin, sensory perception of urge to cough, and fluoroscopic swallow evaluation. Repeated measures and 1-way analyses of variance were used to determine significant differences pre- and posttraining. **RESULTS:** Maximum expiratory pressure increased in all participants by an average of 30cmH₂O posttraining. At baseline, all participants demonstrated a blunted reflex cough response to 200µmol/L of capsaicin. After 5 weeks of training, measures of urge to cough and cough effectiveness increased for reflex cough; however, voluntary cough effectiveness did not increase. Swallow function was minimally impaired at baseline, and there were no significant changes in the measures of swallow function posttraining. **CONCLUSIONS:** EMST improves expiratory muscle strength, reflex cough strength, and urge to cough. Voluntary cough and swallow measures were not significantly different posttraining. It may be that stroke patients benefit from the training for upregulation of reflex cough and thus improved airway protection. Copyright © 2016 American Congress of Rehabilitation Medicine. Published by Elsevier Inc. All rights reserved.

Access or request full text: <https://libkey.io/10.1016/j.apmr.2016.03.027>

4. Effects of expiratory muscle strength training on oropharyngeal dysphagia in subacute stroke patients: a randomised controlled trial.

Authors: Park, J. S.; Oh, D. H.; Chang, M. Y. and Kim, K. M.

Publication Date: May, 2016



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Journal: Journal of Oral Rehabilitation 43(5), pp. 364-372

Abstract: Expiratory muscle strength training (EMST) involves forcible blowing as a means of generating high expiratory pressure, against adjustable resistance. EMST has recently been introduced as a potential treatment for dysphagia. This study was performed to investigate the effects of EMST on the activity of suprahyoid muscles, aspiration and dietary stages in stroke patients with dysphagia. Twenty-seven stroke patients with dysphagia were randomly divided into two groups. The experimental group performed EMST with a 70% threshold value of maximal expiratory pressure, using an EMST device, 5 days a week for 4 weeks. The placebo group trained with a sham device. The EMST regime involved 5 sets of 5 breaths through the EMST device for a total of 25 breaths per day. Activity in the suprahyoid muscle group was measured using surface electromyography (sEMG). Further, the penetration-aspiration scale (PAS) was used to assess the results of the videofluoroscopic swallowing study (VFSS). In addition, dietary stages were evaluated using the Functional Oral Intake Scale (FOIS). The experimental group exhibited improved suprahyoid muscle group activity and PAS results, when compared to the placebo group. Following intervention, statistical analysis indicated significant differences in measured suprahyoid muscle activity ($P = 0.01$), liquid PAS outcomes ($P = 0.03$) and FOIS results ($P = 0.06$), but not semisolid type PAS outcomes ($P = 0.32$), between the groups. This study confirms EMST as an effective treatment for the development of suprahyoid muscle activity in stroke patients with dysphagia. Additionally, improvements in aspiration and penetration outcomes were observed. Copyright © 2016 John Wiley & Sons Ltd.

Access or request full text: <https://libkey.io/10.1111/joor.12382>

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Journal articles

1. Effect of Combined Respiratory Muscle Training (cRMT) on Dysphonia following Single CVA: A Retrospective Pilot Study

Authors: Arnold, Robert J.; Gaskill, Christopher S. and Bausek, Nina

Publication Date: /07// ,2023

Journal: Journal of Voice 37(4), pp. 529-538

Abstract: Although dysphonia is less prevalent than dysphagia following cerebrovascular accidents, dysphonia does contribute to the burden of disease resulting from stroke. Strengthening muscles of the larynx and respiratory tract through respiratory muscle training (RMT) has proven effective in improving voice after neurological insult. However, approaches to strengthen only the expiratory muscle groups (EMST) dominate the clinical study literature, with variable outcomes. By focusing on exhalation, the contribution of inspiratory muscles to phonation may have been overlooked. This study investigated the effect of combined respiratory muscle training (cRMT) to improve voice function in stroke patients. Recorded data of twenty patients with dysphonia following stroke were allocated to an intervention (IG) or a control group (CG) based upon whether they chose cRMT or not while awaiting pro bono voice therapy services. The intervention group ($n = 10$) was treated daily with three 5-minute sessions of combined resistive respiratory muscle training for 28 days, while the control group ($n = 10$) received no cRMT or other exercise intervention.



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Perceptual and acoustic measurements as well as a pulmonary function test were assessed pre-and post-intervention. The intervention group demonstrated significant improvements after 28 days of cRMT in peak flow (127%), patient self-perception of voice improvement (84.41%), as well as in all categories of the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V): overall severity (63.22%), roughness (54.76%), breathiness (61.06%), strain (63.43%), pitch range (48.11%) and loudness (57.51%), compared to the control group who did not receive treatment. Furthermore, cRMT also led to significant improvements in maximum phonation time (212.5%), acoustic parameters of vocal intensity, and total semitone range (165.45%). This pilot study shows promise of the feasibility and effectiveness of cRMT to lessen the signs and symptoms of dysphonia while simultaneously improving breath support.

Access or request full text: <https://libkey.io/10.1016/j.jvoice.2021.03.014>

2. Effect of Expiratory Muscle Training on Stomatognathic System in Patients with Stroke

Authors: Dursun, Ömer;Çankaya, Tamer and Dilekçi, Erdal

Publication Date: /09// ,2023

Journal: Karya Journal of Health Science 4(3), pp. 179-186

Abstract: Objective: The aim of this study was to assess the effect of expiratory muscle training on the stomatognathic system in patients with stroke. Method: A total of 31 patients with stroke were included in the study: 16 patients with stroke (age=66.63±8.38, height=166.38±8.59, BMI=28.09±4.81) as the control group and 15 patients with stroke (age=65.60±7.62, height=168.20±8.78, BMI=28.95±6.92) as the study group. Temporomandibular joint range of motion and dysfunction, pressure pain threshold of masticatory muscles, facial asymmetry existence, head posture, oral hygiene, oral hygiene habit, masticatory performance, intraoral pH, deglutition, and deep neck flexor muscle endurance of the patients with stroke were assessed. Assessment methods were in order by digital caliper, the Fonseca Questionnaire, algometry, labial commissure and craniocervical angle measurement, general oral health assessment index, and questionnaire, sieve test, digital pH gauge, repetitive saliva swallow test, Eating Assessment Tool, and deep neck flexor endurance test. Patients with stroke in the study group were enrolled in an expiratory muscle training program consisting of 5 sets of 10 repetitions daily for three weeks in addition to conventional physiotherapy; the control group enrolled in the conventional physiotherapy program. Patients with stroke in the study group were called twice a week to assess their compliance with the expiratory muscle training. Results: In intragroup comparison significant increase was found in the inferior portion of the left masseter, mandibular protrusion, and a decrease in labial commissure angle and Fonseca Questionnaire score of the control group (p0.05). While significant difference was found in lateral deviation, eating assessment inventory and labial commissure angle in intergroup comparison (p0.05). Improvement in labial commissure angle was in favor of the control group (p0.05).

Access or request full text: <https://libkey.io/10.52831/kjhs.1269302>

3. Scoping review to identify and map non-pharmacological, non-surgical treatments for dysphagia following moderate-to-severe acquired brain injury

Authors: Eskildsen, Signe Janum;Poulsen, Ingrid;Jakobsen, Daniela;Riberholt, Christian



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Gunge and Curtis, Derek John

Publication Date: 12 02 ,2021

Journal: BMJ Open 11(12), pp. e053244

Abstract: INTRODUCTION: Dysphagia is a common and critical consequence of acquired brain injury (ABI) and can cause severe complications. Dysphagia rehabilitation is transforming from mainly compensatory strategies to the retraining of swallowing function using principles from neuroscience. However, there are no studies that map interventions available to retrain swallowing function in patients with moderate-to-severe ABI. **OBJECTIVE:** To systematically map the accessible research literature to answer the research question: Which non-surgical, non-pharmacological interventions are used in the treatment of dysphagia in patients with moderate and severe ABI in the acute and subacute phase? **DESIGN:** Scoping review based on the methodology of Arksey and O'Malley and methodological advancement by Levac et al. **DATA SOURCES:** MEDLINE, Embase, Cochrane Library, CINAHL, PsycINFO, Web of Science, OTseeker, speechBITE and PEDro were searched up until 14 March 2021. **ELIGIBILITY CRITERIA:** All studies reporting rehabilitative interventions within 6 months of injury for patients with moderate-to-severe ABI and dysphagia were included. **DATA EXTRACTION AND SYNTHESIS:** Data was extracted by two independent reviewers and studies were categorised based on treatment modality. **RESULTS:** A total of 21 396 records were retrieved, and a final of 26 studies were included. Interventions were categorised into cortical or non-cortical stimulation of the swallowing network. Cortical stimulation interventions were repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation. Non-cortical were complex swallowing interventions, neuromuscular electrical stimulation, pharyngeal electrical stimulation (PES), sensory stimulation, strengthening exercises and respiratory muscle training. **CONCLUSION:** This scoping review provides an overview of rehabilitative dysphagia interventions for patients with moderate and severe ABI, predominantly due to stroke, in the acute and subacute phase. Positive tendencies towards beneficial effects were found for rTMS, complex swallowing interventions, PES and cervical strengthening. Future studies could benefit from clear reporting of patient diagnosis and disease severity, the use of more standardised treatment protocols or algorithms and fewer but standardised outcome measures to enable comparison of effects across studies and interventions. Copyright © Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

Access or request full text: <https://libkey.io/10.1136/bmjopen-2021-053244>

4. Electromyographic study assessing swallowing function in subacute stroke patients with respiratory muscle weakness.

Authors: Liaw, Mei-Yun;Lin, Meng-Chih;Leong, Chau-Peng;Wang, Lin-Yi;Pong, Ya-Ping;Yang, Tsung-Hsun and Huang, Yu-Chi

Publication Date: Dec 03 ,2021

Journal: Medicine 100(48), pp. e27780

Abstract: BACKGROUND: Dysphagia has been reported to be associated with the descent of the hyolaryngeal complex. Further, suprahyoid muscles play a greater role than infrahyoid muscles in elevation of the hyolaryngeal complex. Respiratory muscle training (RMT) can improve lung function, and expiratory muscle strength training can facilitate elevation of the



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hyoid bone and increase the motor unit recruitment of submental muscles during normal swallowing. This study aimed to investigate the surface electromyography (sEMG) of the swallowing muscles, bilaterally, and the effect of RMT on swallowing muscles in stroke patients with respiratory muscle weakness. **METHODS:** Forty patients with first episode of unilateral stroke were included in this retrospective controlled trial. After exclusion of 11 patients with respiratory muscle strength stronger than 70% of the predicted value, 15 were allocated to the RMT group and 14 to the control group. However, eventually, 11 patients in RMT group and 11 patients in control group completed the study. The sEMG of the orbicularis oris, masseter, submental, and infrahyoid muscles were recorded during dry swallowing, water swallowing (2 mL), and forced exhalation against a threshold breathing trainer set at different intensities, at baseline and after 6-week RMT. **RESULTS:** Regarding the sEMG of submental muscles, there were significant between-group differences on the latency of the unaffected side ($P = .048$), significant change from baseline force on the unaffected side ($P = .035$), and significant between-side difference ($P = .011$) in the RMT group during dry swallowing. Significant change in the duration from baseline was observed on the affected side of the RMT group when blowing was set at 50% maximal expiratory pressure (MEP; $P = .015$), and on the unaffected side of the control group when blowing set at 15% MEP ($P = .005$). Significant difference was observed in the duration between 50% MEP and 15% MEP after 6-week program in the control group ($P = .049$). **CONCLUSIONS:** A 6-week RMT can improve the electric signal of the affected swallowing muscles with more effect on the unaffected side than on the affected side during dry swallowing. Furthermore, RMT with 50% MEP rather than 15% MEP can facilitate greater submental muscle activity on the affected side in stroke patients with respiratory muscle weakness. Copyright © 2021 the Author(s). Published by Wolters Kluwer Health, Inc.

Access or request full text: <https://libkey.io/10.1097/MD.0000000000027780>

5. Effect of respiratory muscle training on dysphagia in stroke patients-A retrospective pilot study.

Authors: Arnold, Robert J. and Bausek, Nina

Publication Date: Dec ,2020

Journal: Laryngoscope Investigative Otolaryngology 5(6), pp. 1050-1055

Abstract: BACKGROUND: Dysphagia is prevalent with cerebrovascular accidents and contributes to the burden of disease and mortality. Strengthening dysfunctional swallow muscles through respiratory muscle training (RMT) has proven effective in improving swallow effectiveness and safety. However, approaches to strengthen only the expiratory muscle groups (EMST) dominate the clinical study literature, with variable outcomes. This study investigated the effect of simultaneous inspiratory-expiratory muscle strengthening to improve swallowing function in stroke patients. **METHODS:** Recorded data of 20 patients receiving pro bono medical care for dysphagia following stroke were allocated to intervention (IG) or control group (CG) based upon whether they chose combined RMT (cRMT) or not while awaiting swallow therapy services. The intervention group was treated with three 5-minute sessions of resistive respiratory muscle training for 28 days, while the control group received no RMT or other exercise intervention. Respiratory and swallow outcomes were assessed pre- and post-intervention and included Mann Assessment of Swallowing Ability (MASA), fiberoptic endoscopic evaluation of swallowing (FEES) with penetration-aspiration scale (PAS), functional oral intake scale (FOIS), patient visual analogue scale (VAS), and peak expiratory flow (PEF). **RESULTS:** After 28 days, the intervention group demonstrated greater improvements (P value : After 28 days, the



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intervention group demonstrated greater improvements (P value **CONCLUSION:** cRMT is a feasible and effective method to improve signs and symptoms of dysphagia while improving airway protection. **LEVEL OF EVIDENCE:** 3. Copyright © 2020 The Authors. Laryngoscope Investigative Otolaryngology published by Wiley Periodicals LLC on behalf of The Triological Society.

Access or request full text: <https://libkey.io/10.1002/lio2.483>

6. Benefits of Home-Based Respiratory Muscle Training from the Perspectives of Individuals Who Had a Stroke: Qualitative Study.

Authors: de Menezes, Kenia Kiefer Parreiras; Nascimento, Lucas Rodrigues; Avelino, Patrick Roberto and Teixeira-Salmela, Luci Fuscaldi

Publication Date: 2020

Journal: Pm & R 12(10), pp. 990-996

Abstract: **BACKGROUND:** Although the significance of respiratory muscle training has been established in the literature, there is a need to understand the participants' perceptions of the benefits of this intervention. **OBJECTIVE:** To understand how individuals who had a stroke perceive changes in their body functions and structures, activities, and participation after a high-intensity respiratory muscle training intervention and to understand their perceptions of the benefits and limitations of a home-based intervention. **DESIGN:** Qualitative study. **SETTING:** Community-dwelling patients. **PATIENTS:** Fifteen individuals who had a stroke. **METHODS:** For this qualitative study, interviews were conducted using a semistructured questionnaire about topics related to participation in a home-based respiratory muscle training intervention. The interviews were transcribed and analyzed using thematic content analysis. **RESULTS:** Fifteen participants were interviewed. Most of the participants reported positive perceptions of body functions and structures, grouped into two thematic categories (breathing and speech); activity, also grouped into two thematic categories (walking and domestic activities); and participation, grouped into one thematic category (community-leisure activities). Answers about the benefits of a home-based intervention were grouped into three thematic categories (no need to leave home, commitment to training, and comfort). All participants reported that they would recommend the intervention to other stroke patients and that they were either satisfied or very satisfied with the intervention. Most (80%) participants did not consider the intervention difficult to perform. **CONCLUSION:** Individuals who had experienced a stroke perceived the benefits of high-intensity home-based respiratory muscle training in all components of function. Copyright © 2020 American Academy of Physical Medicine and Rehabilitation.

Access or request full text: <https://libkey.io/10.1002/pmrj.12324>

7. Efficacy of Interventions to Improve Respiratory Function After Stroke

Authors: Menezes KK, Nascimento LR, Avelino PR, Alvarenga MTM, Teixeira-Salmela LF.

Publication Date: /5, 2018

Journal: Respiratory Care 63, pp. 920-933



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Abstract: Efficacy of Interventions to Improve Respiratory Function After Stroke. The aim of this study was to systematically review all current interventions that have been utilized to improve respiratory function and activity after stroke. Specific searches were conducted. The experimental intervention had to be planned, structured, repetitive, purposive, and delivered with the aim of improving respiratory function. Outcomes included respiratory strength (maximum inspiratory pressure P_I, maximum expiratory pressure P_E) and endurance, lung function (FVC, FEV₁, and peak expiratory flow PEF), dyspnea, and activity. The quality of the randomized trials was assessed by the PEDro scale using scores from the Physiotherapy Evidence Database (www.pedro.org.au), and risk of bias was assessed in accordance with the Cochrane Handbook for Systematic Reviews of Interventions. The 17 included trials had a mean PEDro score of 5.7 (range 4-8) and involved 616 participants. Meta-analyses showed that respiratory muscle training significantly improved all outcomes of interest: P (weighted mean difference 11 cm H₂O, 95% CI 7-15, I = 0%), P (8 cm H₂O, 95% CI 2-15, I = 65%), FVC (0.25 L, 95% CI 0.12-0.37, I = 29%), FEV₁ (0.24 L, 95% CI 0.17-0.30, I = 0%), PEF (0.51 L/s, 95% CI 0.10-0.92, I = 0%), dyspnea (standardized mean difference -1.6 points, 95% CI -2.2 to -0.9; I = 0%), and activity (standardized mean difference 0.78, 95% CI 0.22-1.35, I = 0%). Meta-analyses found no significant results for the effects of breathing exercises on lung function. For the remaining interventions (ie, aerobic and postural exercises) and the addition of electrical stimulation, meta-analyses could not be performed. This systematic review reports 5 possible interventions used to improve respiratory function after stroke. Respiratory muscle training proved to be effective for improving inspiratory and expiratory strength, lung function, and dyspnea, and benefits were carried over to activity. However, there is still no evidence to accept or refute the efficacy of aerobic, breathing, and postural exercises, or the addition of electrical stimulation in respiratory function.

Access or request full text: <https://libkey.io/10.4187/respcare.06000>

8. Effects of resistance expiratory muscle strength training in elderly patients with dysphagic stroke.

Authors: Eom, Mi-Ja;Chang, Moon-Young;Oh, Dong-Hwan;Kim, Hyun-Dong;Han, Na-Mi and Park, Ji-Su

Publication Date: 2017

Journal: Neurorehabilitation 41(4), pp. 747-752

Abstract: BACKGROUND: Recently, resistance expiratory muscle strength training (EMST) has been reported as a remedial treatment for dysphagia. **OBJECTIVE:** To investigate the effect of resistance EMST on the swallowing function in stroke patients with oropharyngeal dysphagia. **METHODS:** Forty-two stroke patients with dysphagia were randomly assigned to two groups: an experimental group (n = 13) and a placebo group (n = 13). The experimental group performed EMST using a portable EMST device, while the placebo group performed EMST using a sham EMST device with no loading. The intervention was performed 5 days per week for 4 weeks, in five sets of 5 breaths through the device for a total of 25 breaths per day. Both groups underwent conventional dysphagia treatment for 30 minutes/day, 5 days/week, for 4 weeks. Videofluoroscopic dysphagia scale (VDS) and penetration-aspiration scale (PAS) based on a videofluoroscopic swallowing study (VFSS) were assessed to analyze the oropharyngeal swallowing function. **RESULTS:** The experimental group showed more improvement in pharyngeal phase of the VDS (p = 0.018 and 0.006, respectively) and PAS compared to the placebo group (p = 0.014). **CONCLUSIONS:** We suggest that EMST could improve the effects of dysphagia observed in post-stroke elderly



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patients based on swallowing function.

Access or request full text: <https://libkey.io/10.3233/NRE-172192>

9. Effects of expiratory muscle strength training (EMST) on oropharyngeal dysphagia in subacute stroke patients: A randomised controlled trial

Authors: Erfmann, Kerstin

Publication Date: /06// ,2017

Journal: Journal of Clinical Practice in Speech-Language Pathology 19(2), pp. 111

URL: <https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=cin20&AN=124426256&profile=ehost>

10. Respiratory muscle strength training and neuromuscular electrical stimulation in subacute dysphagic stroke patients: a randomized controlled trial

Authors: Guillén-Solà, Anna;Messagi Sartor, Monique;Bofill Soler, Neus;Duarte, Esther;Barrera, M^a C. and Marco, Ester

Publication Date: /06// ,2017

Journal: Clinical Rehabilitation 31(6), pp. 761-771

Abstract: Objective: To evaluate the effectiveness of inspiratory/expiratory muscle training (IEMT) and neuromuscular electrical stimulation (NMES) to improve dysphagia in stroke. Design: Prospective, single-blind, randomized-controlled trial. Setting: Tertiary public hospital. Subjects: Sixty-two patients with dysphagia were randomly assigned to standard swallow therapy (SST) (Group I, controls, n=21), SST+ IEMT (Group II, n=21) or SST+ sham IEMT+ NMES (Group III, n=20). Interventions: All patients followed a 3-week standard multidisciplinary rehabilitation program of SST and speech therapy. The SST+IEMT group's muscle training consisted of 5 sets/10 repetitions, twice-daily, 5 days/week. Group III's sham IEMT required no effort; NMES consisted of 40-minute sessions, 5 days/week, at 80Hz. Main outcomes: Dysphagia severity, assessed by Penetration-Aspiration Scale, and respiratory muscle strength (maximal inspiratory and expiratory pressures) at the end of intervention and 3-month follow-up. Results: Maximal respiratory pressures were most improved in Group II: treatment effect was 12.9 (95% confidence interval 4.5-21.2) and 19.3 (95% confidence interval 8.5-30.3) for maximal inspiratory and expiratory pressures, respectively. Swallowing security signs were improved in Groups II and III at the end of intervention. No differences in Penetration-Aspiration Scale or respiratory complications were detected between the 3 groups at 3-month follow-up. Conclusion: Adding IEMT to SST was an effective, feasible, and safe approach that improved respiratory muscle strength. Both IEMT and NMES were associated with improvement in pharyngeal swallowing security signs at the end of the intervention, but the effect did not persist at 3-month follow-up and no differences in respiratory complications were detected between treatment groups and controls.

Access or request full text: <https://libkey.io/10.1177/0269215516652446>



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11. Effects of resistance expiratory muscle strength training in elderly patients with dysphagic stroke

Authors: Mi-Ja Eom; Moon-Young Chang; Dong-Hwan Oh; Hyun-Dong Kim; Na-Mi Han and Ji-Su Park

Publication Date: /05/15/ ,2017

Journal: NeuroRehabilitation 41(4), pp. 747-752

Abstract: BACKGROUND: Recently, resistance expiratory muscle strength training (EMST) has been reported as a remedial treatment for dysphagia. OBJECTIVE: To investigate the effect of resistance EMST on the swallowing function in stroke patients with oropharyngeal dysphagia. METHODS: Forty-two stroke patients with dysphagia were randomly assigned to two groups: an experimental group (n = 13) and a placebo group (n = 13). The experimental group performed EMST using a portable EMST device, while the placebo group performed EMST using a sham EMST device with no loading. The intervention was performed 5 days per week for 4 weeks, in five sets of 5 breaths through the device for a total of 25 breaths per day. Both groups underwent conventional dysphagia treatment for 30 minutes/day, 5 days/week, for 4 weeks. Videofluoroscopic dysphagia scale (VDS) and penetration aspiration scale (PAS) based on a videofluoroscopic swallowing study (VFSS) were assessed to analyze the oropharyngeal swallowing function. RESULTS: The experimental group showed more improvement in pharyngeal phase of the VDS (p = 0.018 and 0.006, respectively) and PAS compared to the placebo group (p = 0.014). CONCLUSIONS: We suggest that EMST could improve the effects of dysphagia observed in post-stroke elderly patients based on swallowing function.

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12. Effects of expiratory muscle strength training on swallowing function in acute stroke patients with dysphagia.

Authors: Moon, Jong Hoon; Jung, Jin-Hwa; Won, Young Sik; Cho, Hwi-Young and Cho, KiHun

Publication Date: Apr ,2017

Journal: Journal of Physical Therapy Science 29(4), pp. 609-612

Abstract: [Purpose] This study was conducted to identify the effects of expiratory muscle strength training on swallowing function in acute stroke patients with dysphagia. [Subjects and Methods] A total of 18 stroke patients with dysphagia were enrolled in the study. All participants were randomly assigned to either an experimental group (n=9) or a control group (n=9). All participants performed traditional-swallowing rehabilitation therapy in 30-minute sessions five times a week for four weeks; however, only the experimental group received expiratory muscle strength training. [Results] Both groups showed significant improvements after mediation. When compared with the control group, the functional dysphagia scale, vallecular residue, and penetration-aspiration scale were significantly improved in the experimental group. [Conclusion] Expiratory muscle strength training is an effective intervention for impaired swallowing function in acute strike patients with dysphagia.

Access or request full text: <https://libkey.io/10.1589/jpts.29.609>





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	Embase		PsycINFO		Grey Literature
	AMED	X	UpToDate		Other

PURPOSE OF SEARCH			
	Patient info/health & well being	X	Clinical decision making (inc. patient care)
	Executive Team support		Research/Education/Professional development
	Quality Improvement		Primary Care & Neighbourhoods Directorate support
X	KM/Management decision making		Other

USER CATEGORY OF REQUESTOR			
	Medical students		Patients/public
	Nursing/midwifery students		Physician Associates
	Junior doctors		Public Health (Somerset CC)
	Nurses/Midwives		Other
X	Allied Health professionals		





HAS PERMISSION TO SHARE THE RESULTS BEEN OBTAINED FROM THE REQUESTOR?

X	YES - share	NO – do not share
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KEY WORDS/SEARCH STRATEGY INCLUDING MESH HEADINGS	LIMITS USED
<p>Expiratory muscle strength training or EMST or expiratory muscle training or EMT Respiratory function tests/ stroke or cerebrovascular accident or cva or cerebral vascular event or cve or transient ischaemic attack or tia Stroke/ or Ischemic Attack, Transient/ or Cerebrovascular disorders/ Dysphagia or swallow* or deglutition Deglutition Disorders/ Communication or speech or language or talk* or dysarthria Speech disorders/</p>	

