SRIWIJAYA JOURNAL OF MEDICINE

Effectivity of Various Swallowing Exercises in Post-Stroke Dysphagia Patients Rehabilitation: Systematic Review

Faza Al-Apdarrovis[1*], Widya Meiliana[2], Eka Febri Zulissetiana[3]

[1]Medical Profession Study Program. Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia
[2]Medical Rehabilitation Departement, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia
[3]Physiology Departement, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia
*E-mail: fazaalgacvb@gmail.com

Abstract

Post-stroke dysphagia (PSD) affects up to two-thirds of stroke patients, potentially leading to complications such as malnutrition, pneumonia, and increased mortality. This condition results from disrupted neural coordination in the swallowing process, with patients often experiencing severe symptoms. Current treatments combine compensatory strategies and rehabilitative therapies, including swallowing exercises. However, the effectiveness of these exercises remains inconclusive due to small sample sizes and short follow-up periods. This systematic review followed the PRISMA-P 2020 checklist, with literature sourced from PubMed, ScienceDirect, Sage Journals, Cochrane Library, and Proquest using the keywords "Swallowing Exercise" AND "Stroke" AND "Dysphagia.". Eight randomized controlled trials with a total of 278 participants focused on exercises such as head lift exercise (HLE), jaw opening exercise (JOE), oral neuromuscular training, kinesiology taping (KT), Chin Tuck Against Resistance (CTAR), respiratory muscle training (RMT), and community-based rehabilitation. All studies demonstrated improvements in swallowing function, but limitations included small sample sizes, short follow-up periods, and insufficient prior research. This review concludes that swallowing exercises are effective for PSD; however, further research is needed to validate their long-term effectiveness.

Keywords: *Post Stroke Dysphagia,* Swallowing Exercise, Rehabilitation, Physiotherapy

1. Introduction

Post-stroke dysphagia (PSD) is a condition characterized by swallowing dysfunction caused by an imbalance in the coordination of swallowing muscles and neural regulation, preventing patients from eating normally. This condition is typically manifested through symptoms such as excessive saliva production, coughing while drinking, and prolonged mealtimes. The swallowing process involves complex neural pathways, with control centers in the brainstem, cerebral cortex, and cerebellum. Stroke is the most common cause of disruption to these areas, leading to swallowing disorders. Risk factors for PSD include the severity of stroke, measured by NIHSS scores, larger stroke size, and bilateral damage in cases of cortical stroke. Other contributing factors include advanced age, hypertension, and diabetes. Gender differences in PSD risk remain inconclusive, with some studies indicating that men are more likely to experience PSD.[1-4]

According to previous studies, up to two-thirds of stroke patients experience dysphagia, with 75% presenting moderate to severe symptoms. PSD is associated with serious complications such as malnutrition, aspiration pneumonia, and increased mortality. The risk of death in stroke patients with dysphagia is 8.5 times higher, with 30-day mortality ranging from 13.8% to 40%. PSD also leads to decreased health status, depression, and social isolation. While spontaneous recovery may occur within a few weeks, approximately 50% of patients continue to experience swallowing impairments six months post-stroke. The burden of PSD underscores the importance of early intervention to reduce complications and socioeconomic impact.[2-3,5-9]

Current management of post-stroke dysphagia (PSD) involves a combination of compensatory strategies, such as diet modifications and postural adjustments, and rehabilitative therapies targeting swallowing function. Traditional approaches like speech and language therapy (SLT) focus on strengthening swallowing muscles and improving coordination through Shaker's exercise and chin tuck against resistance (CTAR). New methods, including neuromuscular electrical stimulation and pharyngeal electrical stimulation, aim to stimulate neuroplasticity and accelerate recovery. Swallowing exercises, which utilize the principle of neuroplasticity to restore sensorimotor control, show promise but require further studies to confirm their efficacy. Interventions for post-stroke dysphagia often target different aspects of rehabilitation, making direct comparisons across studies challenging. Moreover, the limited evidence on the overall effectiveness of these exercises highlights the need for further research to consolidate findings and establish a stronger evidence base for clinical practice.[5,10-14]

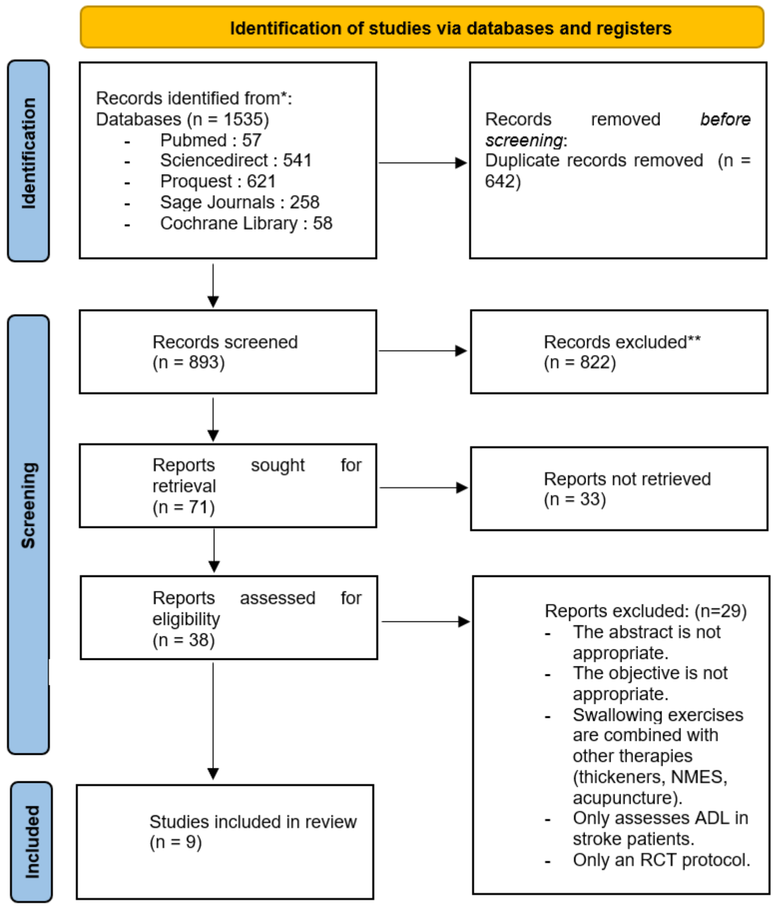

Figure 1. PRISMA Flow Diagram

To provide a comprehensive analysis, a systematic review of recent randomized controlled trials investigating the effectiveness of various swallowing exercises in rehabilitating post-stroke dysphagia needs to be conducted. This review aims to provide the latest evidence-based insights into the impact of swallowing exercises on swallowing function recovery in PSD patients.

2. Method

This systematic literature uses data from articles related to swallowing rehabilitation in post-stroke dysphagia patients using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) methodology. Articles were sourced from several electronic databases, including PubMed, ScienceDirect, Sage Journals, Cochrane Library, and ProQuest, using the keywords: "post-stroke dysphagia" AND "swallowing exercise OR rehabilitation OR physical therapy." Articles included in this study had to meet the following inclusion criteria: 1) Written in English, 2) Address the effectiveness of swallowing exercises in post-stroke dysphagia patients, 3) Be original research using randomized controlled trials, and 4) Published within the last six years. Articles that were not fully accessible were excluded from this study. The findings from the literature search were organized in an extraction table, including the author's name, year, article title, objectives, population, intervention, and main findings. The risk of bias in each study was analyzed using the Cochrane Risk of Bias Tool.

A total of 57 articles were retrieved from PubMed, 541 articles from ScienceDirect, 621 articles from ProQuest, 258 articles from Sage Journals, and 58 articles from the Cochrane Library. After the screening, six articles were selected for the analysis. The PRISMA flow diagram is used to visually represent the process of article selection (Figure 1).

3. Result

Eight studies were included in this systematic review, conducted in various countries such as South Korea, Taiwan, China, India, and Sweden. All eight studies were in the form of Randomized Controlled Trials (RCTs). Each study underwent risk of bias analysis using the Cochrane Risk of Bias Tool (RoB2) via the Review Manager 5.4.1 application (Figures 2 and 3).

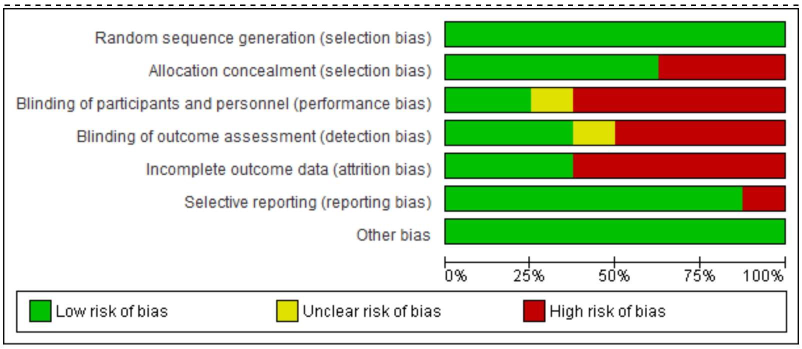

Figure 2. Risk of Bias Graph

Various types of swallowing exercises were applied to post-stroke dysphagia patients, with each rehabilitation method having different objectives, although generally focusing on strengthening the muscles involved in swallowing and improving swallowing function. The characteristics of the reviewed studies are summarized in Table 1, while the descriptions of the swallowing exercises analyzed in this review are summarized in Table 2.

4. Discussion

Post-stroke dysphagia (PSD) is a common and potentially debilitating condition that requires specialized rehabilitation strategies to improve swallowing function, prevent aspiration pneumonia, and enhance quality of life. Various exercises, including Shaker's exercise or Head Lift Exercise (HLE), Jaw Opening Exercise (JOE), Oral neuromuscular training, swallowing with kinesiology taping (KT), Chin Tuck Against Resistance (CTAR), Respiratory Muscle Training (RMT), and Community-Based Rehabilitation, have shown varying levels of effectiveness in rehabilitating swallowing function through mechanisms such as muscle hypertrophy, neural reorganization, and improved functional movement. This systematic review found that these exercises are effective in rehabilitating patients with post-stroke dysphagia.[15–22]

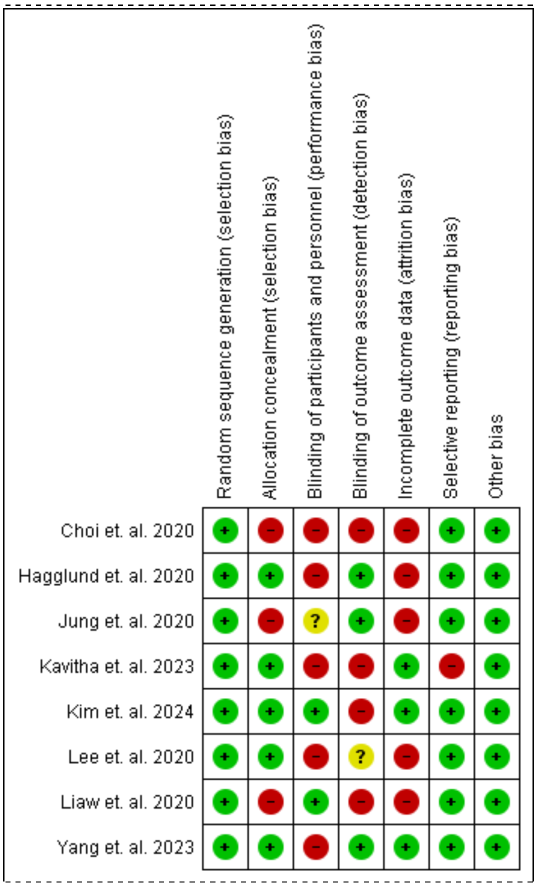

Figure 3. Risk of Bias Analysis with *Cochrane Risk Of Bias Tool* (RoB2)

4.1. Shaker's Exercise and Jaw-Opening Exercise

HLE and JOE are designed to strengthen the suprahyoid muscles, including the digastric and mylohyoid, which are critical for hyoid bone elevation during swallowing. Both exercises enhance muscle thickness and activation, contributing to hypertrophy and increased muscle contraction strength. Resistance exercises improve motor unit recruitment and muscle strength, supporting better hyoid bone movement over 6–8 weeks of training, facilitating epiglottic rotation, and upper esophageal sphincter opening—essential for effective swallowing. HLE enhances tongue strength and functional movement during the oral phase, while both exercises improve the anterior-superior movement of the hyoid bone during the pharyngeal phase, reducing aspiration and improving airway protection. However, patient adherence to HLE may be low due to neck discomfort, making JOE a potential alternative with higher adherence rates.[15,16]

Table 1. Study Characteristics of Post Stroke Dysphagia Rehabilitation

No.	Study	Intervention	Evaluation	Participant	Results
1.	Choi et. al., 2020[15]	Jaw Opening Exercise and Head Lift Exercise	The thickness of suprahyoid muscles and movement of hyoid bones are evaluated through ultrasound.	21 patients	JOE and HLE groups showed a significant increase in digastric and mylohyoid muscle thickness (p = 0.007 and 0.006 for JOE; 0.007 and 0.014 for HLE). The anterior and superior movement of Hyoid bone (p = 0.010 and 0.007 for JOE; 0.006 and 0.013 for HLE). Between JOE and HLE, there is no significant difference.
2.	Lee et. al., 2020[16]	Head Lift Exercise	Swallowing Function evaluated using Videofluoroscopic Dysphagia Scale	25 patients	Patients show a significant increase in the oral and pharynx VD phases (p <0.05) in both groups. No significant difference between them was found (P> 0.05).
3	Hagglund et. al., 2020[17]	Oral neuromuscular training	Swallowing rate evaluated with Timed Water-Swallow Test (TWST) Lip Muscle Force measured with LF100 Swallowing function using videofluoroscopy	40 patients	There is a significant improvement in TWST (intervention, p < 0.001; control, p = 0.001), and swallowing rate had no significant difference. After 12-month follow-up, the patients using oral neuromuscular training showed further improvement compared to the control. Significant differences were shown in TWST (p = 0.032) and lip strength (p = 0.001). A TWST of <10 mL/second at baseline was associated with swallowing dysfunction verified by VFS in all assessed participants.
4.	Jung et. al., 2020[18]	Swallowing Against Kinesiology Taping.	The thickness of the tongue muscle, the mylohyoid muscle, and the anterior digastric muscle using USG	27 patients	There are statistically significant changes in the thickness of the tongue muscle, mylohyoid muscle, and anterior digastric muscle in the KT group compared to the control group (p = 0.007, 0.002, and 0.001).
5.	Kim et. al., 2024[19]	Swallowing Against Kinesiology Taping.	The swallowing function is assessed by VDS and PAS.	30 patients	There are statistically significant improvements in the oral and pharyngeal phases of VDS (p = 0.029 and 0.007, respectively) and PAS (p = 0.034) compared to the placebo group. The effect sizes observed were 0.3 for the oral phase, 0.5 for the pharyngeal phase of VDS, and 1.1 for PAS.
6.	Kavitha et. al., 2023[20]	Chin tuck against resistance (CTAR)	Swallowing function was assessed using the Gugging Swallowing Scale (GUSS) and	40 patients	This study revealed that the pre-assessment mean ± SD of the GUS in the study group was 7.15 ± 3.031 and 6.45 ± 3.692 in the control group. The

			Functional Oral Intake Scale (FOIS).		post-assessment mean values had improved to 15.45 ± 4.006 in the study group and 11.65 ± 3.60 in the control group, with a p-value of 0.003, indicating that this study significantly improved swallowing capacity among stroke patients with dysphagia.
7.	Liaw et. al., 2020[21]	Internal Muscle Training (IMT) and Expiratory Muscle Training (EMT)	MIP, MEP, lung function, peak cough flow, dyspnea perception, Fatigue Assessment Scale, Modified Rankin Scale, Brunnstrom stage, Barthel index, Functional Oral Intake Scale (FOIS), and voice analysis parameters.	31 patients	MIP, FVC, FEV1, fatigue, jitter percentage, amplitude perturbation, and VTI were significantly difference. A negative correlation was observed between the FEV1/FVC ratio and jitter, pitch perturbation, and VTI, while MMEF and MMEF% also showed negative correlations with VTI. Significant differences in Brunnstrom stages, Barthel scores, and FOIS were found before and after training in both groups.
8.	Yang et. al., 2023[22]	Community-Based Group Rehabilitation	Swallowing function was measured using the Standardized Swallowing Assessment (SSA) and FOIS. Emotional health was evaluated with the 15-item Geriatric Depression Scale (GDS-15). Quality of life was assessed using the Swallowing-Related Quality of Life (SWAL-QOL).	64 patients	The swallowing function improved significantly in both groups (p < 0.001); however, there was no significant difference in FOIS changes. Depressive symptoms significantly decreased (p = 0.002), while the control group didn't. Swallowing-related quality of life scores significantly improved in both groups (p < 0.001).

Table 2. Swallowing Exercise Descriptions

Study	Participants, Mean Age ± SD	Mean CVD Onset ± SD	Swallowing Exercise Description	Intensity	Frequency (Days/Week) and Duration
Choi et. al. 2020[15]	Jaw Opening Exercise: 11 patients, 63.47 ± 7.65 years Shaker's Exercise: 10 patients, 61.24 ± 9.73 years)	Jaw Opening Exercise: 12.12 ± 2.21 weeks Shaker's Exercise: 13.35 ± 2.42 weeks	**Jaw Opening Exercise (JOE):** Patients performed JOE using a resistance device made of acrylonitrile-butadiene-styrene resin (LES 100; Cybermedic Inc., Iksan, South Korea). Both isometric and isotonic exercises were included. The isometric exercise involved holding the jaw open against resistance for 10 seconds, while the isotonic exercise required opening the jaw against resistance. **Shaker's Exercise:** This group followed the same type of exercises (isometric and isotonic) and frequency as the JOE. The Shaker's method was conducted according to previous research referenced by the investigators.	Isometric: 10 seconds, 3x Isotonic: 30 times, 3 set	5 days/week, for 6 weeks
Lee et. al., 2020[16]	Shaker's Exercise 0°: 12 patients, 63.00 ± 10.55 years Shaker's Exercise 45°	Shaker's Exercise 0°: 3.00 ± 1.18 months Shaker's Exercise 45°:	The 0° group performed exercises while lying on a flat surface. In contrast, the 45° group performed exercises in a lying position while maintaining a 45° tilt. The angle was controlled using a goniometer.	The frequency was the same for both groups.	3 times a day, 5 days/week, for 4 weeks

	13 patients, 63.40 ± 6.65 years	3.90±1.28 months		Patients held their heads up for 1 minute, followed by 30 repetitive neck lifts.	
Hagglund et. al., 2020[17]	Intervention: 18 participants (75 years old, range: 56–90) Control: 14 participants (75 years old, range: 60–85)	4 weeks	During the training, the device (Muppy®; Dr. Hinz Dental, Herne, Germany) was placed pre-dentally behind the closed lips, and the patient sat with their body and head in an upright position. The participants resisted the device against gradually increasing horizontal pulling force while attempting to resist the force by tightening their lips.	The hold was maintained for 5–10 seconds, repeated 3 times.	3 times a day, every day, for 5 weeks
Jung et al., 2020[18]	Intervention: 13 patients (71.3 ± 6.5 years) Control: 14 patients (70.5 ± 8.2 years)	Intervention: 16.2 ± 5.2 weeks Control: 15.1 ± 6.4 weeks	The patient sat upright in a chair, with the head and neck facing forward, maintaining a neutral position. Three types of KT were prepared and applied to the hyolaryngeal complex. The KT was pulled downward with approximately 70% tension and attached bilaterally to the sternum and clavicle. After the KT application, the subject performed repeated swallowing. A small amount of water was provided to facilitate smooth swallowing.	10 times swallowing, repeated in 5 sessions, with a 2-3 minutes break each session.	10 times a day, every day, for 4 weeks
Kim et. al., 2024[19]	Intervention: 15 participants, 62.17 ± 11.01 years Control: 15 participants, 59.29 ± 10.19 years	Intervention: 7.94 ± 2.52 months Control: 8.29 ± 2.62 months	KT was cut into two shapes: an I-shaped tape and a V-shaped tape. The subject remained seated, facing forward. The I-shaped tape was attached to the sternum, covering the hyolaryngeal complex, and pulled downward with approximately 70-80% tension. The V-shaped tape (also with 70-80% tension) was applied from the hyoid bone to the superior medial surface of the clavicle. The patient affixed the KT to the front of the neck and then performed repeated swallowing.	5 times swallowing, repeated 10 sessions	5 times a week, for 6 weeks
Kavitha et. al., 2023[20]	Intervention: 20 participants, 46.25 ± 15.217 years Control: 20 participants, 54.55 ± 10.313 years	Not mentioned	Participants were instructed to sit upright and hold a rubber ball under their chin, tucking their chin as part of head and neck flexion. **Isometric CTAR**, participants were asked to sit upright and hold the ball under their chin, maintaining a tucked chin position against the device (inflatable rubber ball) with as much force as possible. **In Isotonic CTAR**, participants were instructed to sit upright and hold the ball under their chin. They tucked their chin, pressing as hard as possible against the ball, then lifted their chin.	**Isometric:** Performed 3 times, holding for 60 seconds each, with a 1-minute rest interval between sessions. **Isotonic:** Repeated 30 times.	2 times a day, every day, for 2 weeks

Liaw et. al., 2020[21]	Intervention Group: 11 participants (65.4 ± 11.54 years) Control Group: 10 participants (60.44 ± 10.65 years)	≥ 6 months	**Inspiratory Muscle Training (IMT):** Take a deep and strong breath sufficient to open the valve. **Expiratory Muscle Training (EMT):** Perform a quick and forceful blow to open the valve. The valve used is the Dofin Breathing Trainer (DT 11 or DT 14, Galemed Corporation).	**IMT:** 30–60% of maximum pressure. **EMT:** 15–75% of MEP, repeated 5 times over 5 sessions.	1–2 times/day (1–2 minutes break), 5 times/week, for 6 weeks
Yang, et. al., 2023[22]	Intervention: 30 people, 63.200 ± 6.178 years (Range: 56–77 years) Control: 29 people, 62.483 ± 6.069 years (Range: 56–80 years)	Intervention: 2.62 ± 1.298 months Control: 2.88 ± 1.23 months	The group rehabilitation program includes: 1. **Oral and Facial Rehabilitation Exercises:** Exercises targeting the facial muscles, lips, tongue, jaw, and breathing, along with techniques such as Masako, Shaker's, and airway protection. 2. **Game-Based Biofeedback Training:** Using an electrical stimulator with surface electromyography biofeedback based on a game, patients practice the Mendelsohn swallowing maneuver while matching their waveforms to a standard to receive rewards. 3. **Experience Sharing:** Patients with noticeable progress share their experiences, boosting confidence in the treatment. 4. **Individual Eating Training:** Sessions lasting around 20 minutes focusing on adjusting bolus size, food texture, and posture, with adjustments made by the medical team and Speech-Language Pathologist (SLP).	Each session lasts for 40 minutes of basic training, and the total duration is 1.5 hours. Patients are allowed to rest for 1 minute between each basic training session.	1 times/day, 5 days/week, for 8 weeks

4.2. Oral Neuromuscular Training

Oral neuromuscular training combines sensory stimulation and resistance exercises targeting facial, oral, and pharyngeal muscles, effectively triggering neural reorganization and improving swallowing mechanisms. Studies report improved swallowing rates and lip strength in both short- and long-term follow-ups. This method strengthens swallowing-related muscles, reduces aspiration, and improves oral food intake, distinguishing it from sensory-vibration stimulation alone. Its effectiveness is supported by increased sensory input and motor responses, promoting brain plasticity. Further research is needed to assess its impact on comorbidities like malnutrition, dehydration, and swallowing-related quality of life.[17]

4.3. Swallowing with Kinesiology Taping (KT)

The use of kinesiology taping (KT) during swallowing adds resistance to the suprahyoid muscles, forcing patients to swallow with greater effort, which enhances muscle activation. This contributes to improved muscle thickness, strength, and motor unit recruitment. Studies indicate that KT significantly increases intraoral pressure, suprahyoid muscle activity, swallowing efficiency, and reduces pharyngeal residue. Swallowing against KT also strengthens tongue muscles, facilitating bolus clearance and airway protection. The success of this method depends on proper tape tension application (around 70%), ensuring resistance without compromising patient comfort.[18,19]

4.4. Chin Tuck Against Resistance (CTAR)

CTAR is another resistance-based exercise targeting suprahyoid muscles, improving swallowing safety and reducing aspiration risk. By requiring patients to perform chin-tuck movements against a resistance device, CTAR strengthens key swallowing muscles such as the geniohyoid and mylohyoid. Clinical studies show that CTAR improves swallowing capacity and reduces residue in the vallecula and pyriform sinuses, leading to enhanced functional dysphagia scores (FDS).[20]

4.5. Respiratory Muscle Training (RMT)

RMT focuses on strengthening respiratory muscles to support swallowing and coughing reflexes, which are critical for airway protection. A six-week RMT program improves maximal inspiratory pressure (MIP), peak cough flow, and forced vital capacity (FVC), demonstrating better inhalation-exhalation coordination. Although RMT primarily targets respiratory functions, its benefits extend to neuromuscular coordination, including swallowing processes. However, its effects on expiratory muscle strength and swallowing function require further investigation, especially in stroke patients.[21]

4.6. Community-Based Rehabilitation

Community-based rehabilitation effectively addresses post-stroke dysphagia by combining swallowing exercises and psychosocial support. These programs improve swallowing function (as indicated by improved FOIS scores) and provide tailored eating guidance. Group settings also foster emotional well-being, reduce depressive symptoms, and enhance motivation and social interaction, which are crucial for rehabilitation adherence. Participants report satisfaction from building friendships and sharing experiences, reinforcing their commitment to recovery. These holistic benefits highlight the value of community-based rehabilitation in supporting long-term adaptation and reintegration into daily life.[22]

4.7. Limitations

This systematic review identifies several limitations, such as small sample sizes, difficulty recruiting participants, and high dropout rates. Many studies relied on subjective measurements rather than objective evaluations (e.g., VFS) and faced methodological issues, such as variations in exercise intensity and short follow-up durations. Additionally, inconsistencies in participant characteristics and insufficient control of variables may introduce bias. Future research should focus on larger, controlled studies with standardized protocols and longer follow-ups to validate the effectiveness of these interventions.[15–22]

5. Conclusion

Swallowing exercises have been proven effective in rehabilitating post-stroke dysphagia through mechanisms such as muscle hypertrophy, neural reorganization, and improved functional movement. These exercises target specific aspects of the swallowing mechanism, such as hyoid bone elevation, tongue strength, and airway protection, thereby enhancing the oral and pharyngeal phases of the swallowing process.

Although each method has its advantages, factors such as patient adherence, comfort, and specific rehabilitation goals should guide the selection of exercises. A multimodal approach combining these exercises may offer the most comprehensive benefits, addressing the complex needs of post-stroke dysphagia patients and significantly improving their overall quality of life.

References

1. Farpour, S., Asadi-Shekaari, M., Borhani Haghighi, A., & Farpour, H. R. (2023). Improving Swallowing Function and Ability in Post Stroke Dysphagia: A Randomized Clinical Trial. Dysphagia, 38(1).
2. Wen, X., Liu, Z., Zhong, L., Peng, Y., Wang, J., Liu, H., & Gong, X. (2022). The Effectiveness of Repetitive Transcranial Magnetic Stimulation for Post-stroke Dysphagia: A Systematic Review and Meta-Analysis. In Frontiers in Human Neuroscience (Vol. 16).
3. Wen, X., Liu, Z., Zhong, L., Peng, Y., Wang, J., Liu, H., & Gong, X. (2022). The Effectiveness of Repetitive Transcranial Magnetic Stimulation for Post-stroke Dysphagia: A Systematic Review and Meta-Analysis. In Frontiers in Human Neuroscience (Vol. 16).
4. Ayodele Sasegbon, et al. "The Neurorehabilitation of Post-Stroke Dysphagia: Physiology and Pathophysiology." Journal of Physiology, 22 Mar. 2024.
5. Zhang, Bohan, et al. "Effects of Non-Pharmacological Interventions on the Swallowing Function of Patients with Post-Stroke Dysphagia: A Systematic Review and Network Meta-Analysis." Journal of Oral Rehabilitation, 12 Nov. 2024.
6. Marin, S., Ortega, O., Serra-Prat, M., Valls, E., Pérez-Cordón, L., & Clavé, P. (2023). Economic Evaluation of Clinical, Nutritional and Rehabilitation Interventions on Oropharyngeal Dysphagia after Stroke: A Systematic Review. Nutrients, 15(7), 1714.
7. Yoshimura, Y., Wakabayashi, H., Nagano, F., Bise, T., Shimazu, S., & Shiraishi, A. (2020). Chair-stand exercise improves post-stroke dysphagia. Geriatrics & Gerontology International, 20(10), 885–891.
8. Khedr, E. M., Abbass, M. A., Soliman, R. K., Zaki, A. F., & Gamea, A. (2021). Post-stroke dysphagia: frequency, risk factors, and topographic representation: hospital-based study. Egyptian Journal of Neurology, Psychiatry and Neurosurgery, 57(1).
9. Gu, Haiyan, and Dan Ren. "Prevalence and Risk Factors of Poststroke Dysphagia: A Meta-Analysis." Cerebrovascular Diseases, 20 Apr. 2024.
10. Nerea Gómez-García, et al. "Transcranial Direct Current Stimulation for Post-Stroke Dysphagia: A Meta-Analysis." Journal of Neuroengineering and Rehabilitation, vol. 20, no. 1, 11 Dec. 2023.
11. Zhang, Wen, et al. "A Randomized Controlled Study Investigating the Efficacy of Electro-Acupuncture and Exercise-Based Swallowing Rehabilitation for Post-Stroke Dysphagia: Impacts on Brainstem Auditory Evoked Potentials and Cerebral Blood Flow." Medicine,
12. Sproson, Lise, et al. "Combined Electrical Stimulation and Exercise for Swallow Rehabilitation Post-Stroke: A Pilot Randomized Control Trial." International Journal of Language & Communication Disorders, vol. 53, no. 2, 30 Dec. 2017, pp. 405–417.

13. Mj, K. (n.d.). Effect of Chin Tuck Against Resistance (CTAR) Exercise to Improve Swallowing Capacity among Stroke Patients with Dysphagia: A Randomized Controlled Trial.
14. Fang, W. juan, Zheng, F., Zhang, L. zhi, Wang, W. hui, Yu, C. chen, Shao, J., & Wu, Y. jin. (2022). Research progress of clinical intervention and nursing for patients with post-stroke dysphagia. In Neurological Sciences (Vol. 43, Issue 10).
15. Choi, J. B., Jung, Y. J., & Park, J. S. (2020). Comparison of 2 types of therapeutic exercise: jaw opening exercise and head lift exercise for dysphagic stroke: A pilot study. *Medicine (United States)*, *99*(38), E22136.
16. 17. Hwang, N.-K., Lee, J.-Y., Kim, D.-G., Lee, H.-J., Park, J.-S., Yoon, T.-H., Jung, Y.-J., & Hong, J.-Y. (2020). Effects of Head Lift Exercise on Oropharyngeal Swallowing Function and Dropout Rate According to Reclining Angle in Patients with Dysphagia after Stroke: A Randomized Trial. Journal of the Korean Dysphagia Society, 10(2), 159–166.
17. Hägglund, P., Hägg, M., Levring Jäghagen, E., Larsson, B., & Wester, P. (2020). Oral neuromuscular training in patients with dysphagia after stroke: a prospective, randomized, open-label study with blinded evaluators. *BMC Neurology*, *20*(1).
18. Young-Jin, J., Hee-Jeong, K., Jong-Bae, C., Ji-Su, P., & Hwang, N.-K. (2020). Effect of Dysphagia Rehabilitation Using Kinesiology Taping on Oropharyngeal Muscle Hypertrophy in Post-Stroke Patients: A Double Blind Randomized Placebo-Controlled Trial. Healthcare, 8(4), 411.
19. Kim, H. H., & Park, J. S. (2024). Effects of effortful swallowing against kinesiology taping resistance on the swallowing function in patients with poststroke dysphagia: A randomized controlled trial. *Medicine (United States)*, *103*(21), E38344.
20. Kavitha S, Kumari M, Ramkumar S, Jayachandran. Effect of Chin Tuck Against Resistance (CTAR) Exercise to Improve Swallowing Capacity among Stroke Patients with Dysphagia: A Randomized Controlled Trial. Scope. 2023 Dec 4;13(4):149–56.
21. 1. Liaw, M. Y., Hsu, C. H., Leong, C. P., Liao, C. Y., Wang, L. Y., Lu, C. H., & Lin, M. C. (2020). Respiratory muscle training in stroke patients with respiratory muscle weakness, dysphagia, and dysarthria - a prospective randomized trial. Medicine (United States), 99(10).
22. 23. Yang, C., Zhao, F., Xie, C., Zhang, Y., Dou, Z., & Wei, X. (2023). Community-based group rehabilitation program for stroke patients with dysphagia on quality of life, depression symptoms, and swallowing function: a randomized controlled trial. BMC Geriatrics, 23(1).