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Role of Respiratory Physiotherapy in Emphysema Management: Respirometer Training and Pursed-Lip Breathing

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Abstract

Emphysema damages the alveolar walls and removes much of the lung's elastic recoil, so air gets trapped and every breath costs more effort. Physiotherapy cannot repair this damage, but it can make breathing easier to manage. This review looks at two breathing-based approaches used in emphysema care: Romson's respirometer training and pursed-lip breathing. It describes how emphysema changes lung mechanics, how each technique is performed, and what physiological benefit each may offer. Pursed-lip breathing slows expiration and keeps small airways open longer, which may reduce air trapping and breathlessness. Respirometer training gives visual feedback and encourages steady inspiratory effort, though evidence specific to emphysema is still thin. Findings from published studies on pulmonary physiotherapy and inspiratory muscle training are also considered. Both methods appear useful as part of pulmonary rehabilitation when taught properly and adjusted to patient tolerance.

Keywords: *Emphysema; Respiratory Physiotherapy; Pursed-Lip Breathing; Romson's Respirometer; Pulmonary Rehabilitation.*

INTRODUCTION

Emphysema is a long-term lung condition that mostly affects the alveoli, the tiny air sacs of the lungs, and it is usually counted as a major form of chronic obstructive pulmonary disease (COPD). It builds up slowly. The walls of the alveoli get damaged, and the lung tissue loses some of its natural stretch. Because of this, the lungs find it harder to push air out when a person breathes out. Some damaged sacs also join together into larger spaces, which cuts down the surface available for gas exchange [1]. Air trapping is one of the biggest problems here: a good amount of air stays inside the lungs even after exhaling, so the next breath becomes harder and takes more effort. People often report breathlessness, ongoing discomfort in breathing, tiredness, and low tolerance for physical activity. As the disease advances, even ordinary tasks like walking, climbing stairs or doing housework can feel like a struggle [2], [3].

Respiratory physiotherapy supports patients with these problems. It helps them gain better control of their breathing and manage daily activities more easily. It cannot undo the structural damage in the lungs, but suitable breathing techniques may ease discomfort and make breathing more efficient [4]. Two approaches that get a lot of attention are respirometer training and pursed-lip breathing, which work in different ways. Romson's respirometer is a training device that encourages slow, controlled inspiration. Pursed-lip breathing, in contrast, needs no equipment. The person breathes in slowly through the nose and breathes out gently through lips that are partly closed. This lengthens expiration and may stop the small airways from closing too early [5]. When these methods are done correctly and within the person's own tolerance, they can sit inside a wider pulmonary rehabilitation programme. The aim of such a programme is better breathing control, less breathlessness, and the ability to stay independent in everyday life.

RESPIRATORY DYSFUNCTION IN EMPHYSEMA AND THE NEED FOR PHYSIOTHERAPY

In emphysema, normal lung mechanics change a lot. The alveolar walls get destroyed and the lungs lose their elastic recoil, so they can't contract the way they used to. Air then doesn't leave properly when a person breathes out. The weakened airways may narrow or even collapse during expiration, and some air stays trapped inside [6]. This is called dynamic hyperinflation. It raises the amount of air left in the lungs, which makes the next breath harder to take. The respiratory muscles, the diaphragm especially, have to work more just to keep ventilation adequate. Over time this extra effort leads to tiredness, breathing discomfort and poor physical endurance. Oxygen supply can also suffer when ventilation and gas exchange are impaired, mostly during exertion [7].

Respiratory physiotherapy helps as a supporting part of pulmonary rehabilitation. Its focus is better breathing control and less effort for each breath. Pursed-lip breathing keeps some pressure in the airways while the person breathes out, so the airways may close later and less air gets trapped [8]. Respirometer exercises encourage slow, controlled breathing and some activity of the respiratory muscles. Add suitable physical activity and breathing retraining, and patients may cope better with breathlessness during everyday tasks. The goal here is not to fix the lung damage. It is to make breathing more manageable and to support better functional capacity [9].

Table 1: Major Respiratory Changes in Emphysema and the Role of Physiotherapy

Respiratory changes	Effects on patients	Physiotherapy relevance
Alveolar wall destruction	Reduced surface area for gas exchange	Breathing exercises support better control of ventilation.
Loss of elastic recoil	Difficulty in expelling air from the lungs	Pursed-lip breathing may support prolonged expiration.
Airway collapse and air trapping	Incomplete expiration and dynamic hyperinflation	Controlled breathing may help reduce expiratory discomfort.
Increased respiratory muscle workload	Fatigue and greater effort during breathing	Respirometer training may support inspiratory muscle activity.
Impaired ventilation and gas exchange	Breathlessness and reduced exercise tolerance	Pulmonary rehabilitation helps improve functional capacity and activity tolerance.

RESPIROMETER TRAINING IN EMPHYSEMA MANAGEMENT

Romson's respirometer is a breathing exercise device. It encourages controlled inspiration and gives the patient visual feedback during training. Usually it has a mouthpiece, a breathing tube, and chambers with movable indicators that react to the flow of air being inhaled [10]. For the exercise, the patient sits comfortably, keeps the device upright, and holds the mouthpiece firmly between the lips. One slow, steady breath is taken in, and the indicators rise according to how much airflow the patient produces. If it is tolerated, the breath is held for a moment, then the patient breathes out normally. The cycle is repeated a few times, with short rests in between so the patient doesn't wear out [11].

In emphysema management, these exercises may build awareness of breathing patterns and encourage regular inspiratory effort. Controlled inhalation can support the respiratory muscles and improve coordination while breathing. Lung expansion may also be encouraged, though how much depends on the type of respirometer and on the patient's own respiratory condition. Technique matters a great deal. Forceful or repeated deep breaths can cause discomfort and tiredness in patients who are severely breathless [12]. Training should therefore match what the individual can tolerate, and a physiotherapist should supervise, particularly in the first sessions. The respirometer is a supportive breathing exercise, not a treatment that can reverse alveolar damage. Evidence showing that it works specifically in emphysema is still limited. Its benefits also shouldn't be assumed equal to those of incentive spirometry or dedicated inspiratory muscle training devices [13].

Table 2: Respirometer Training: Technique and Potential Benefits in Emphysema

Component	Description / potential benefit
Device structure	Mouthpiece, breathing tube, and movable indicators for visual feedback.
Starting position	Comfortable sitting position with the device held upright.

Breathing technique	Slow and controlled inspiration through the mouthpiece.
Breathing pattern	Brief breath-holding, if tolerated, followed by normal expiration.
Respiratory muscle activity	Encourages controlled inspiratory effort and breathing coordination.
Lung expansion	May support inspiratory volume and ventilation during exercise.
Clinical supervision	Helps maintain correct technique and prevents excessive breathing effort.
Limitations	Benefits in emphysema require further clinical evaluation, particularly for specific Romson respirometer models.

PURSED-LIP BREATHING: TECHNIQUE AND PHYSIOLOGICAL BENEFITS

Pursed-lip breathing (PLB) is a simple technique that respiratory physiotherapists often use to help patients manage breathlessness, especially in emphysema and COPD. Its main focus is slowing down expiration and keeping better control over how air leaves the lungs. No special equipment is needed, and it is easy to perform [14]. The patient usually sits comfortably, relaxes the shoulders, and breathes in slowly through the nose. Then the lips are pressed gently together, like when blowing out a candle, and the air goes out slowly through the small opening. Breathing out should take longer than breathing in, and the air should never be forced. The pattern can be repeated whenever breathlessness comes on, and also during routine physical activities [15].

The key physiological benefit is a slight positive pressure that builds up inside the airways during expiration. This pressure may keep the smaller airways open for longer and reduce their early collapse. Air then moves out more gradually, which may cut down air trapping and make breathing feel more comfortable. PLB also slows the respiratory rate and gives expiration more time, particularly in patients whose breathing is rapid and shallow [16]. Some people find walking, climbing stairs or doing housework easier with this pattern. But it doesn't work well without proper instruction and regular practice. Excessive or forceful breathing should be avoided, since it may add to the discomfort instead of relieving it [17].

Table 3: Pursed-Lip Breathing Technique and Its Potential Physiological Benefits

Component	Description / potential benefit
Basic principle	Controlled expiration through partially closed lips.
Inhalation	Slow breathing through the nose.
Exhalation	Gentle and prolonged breathing through pursed lips.
Positive expiratory pressure	Helps maintain pressure within the airways during expiration.
Airway stability	May reduce premature collapse of smaller airways.
Respiratory rate	Encourages slower and more controlled breathing.
Air trapping	May help reduce incomplete expiration and dynamic hyperinflation.
Functional benefits	May reduce breathlessness during walking and routine activities.
Patient education	Correct technique and regular practice are important for effective use.

LITERATURE REVIEW

(Curiale et al., 2025) [18] built a localized foundational model of density change to find regions of the lung that point toward emphysema progression. At the center of it is the Local Emphysema Progression (LEP) score. It takes the activations from small areas of lung tissue and combines them into one risk measure for each subject. To test the model, they used 3728 COPDGene participants, comparing baseline with the 5-year scan, and 1421 scans from the 5-year to 10-year interval. A further 1058 ECLIPSE participants were used to replicate the findings. The model picked out progressing lung regions well, with an AUC of 0.88. Among subjects whose emphysema progressed (Δ%LAA-950 > 0), the LEP score correlated with the change in low attenuation areas below −950 Hounsfield Units, at 0.50 in COPDGene and 0.40 in ECLIPSE. It was also linked to mortality and several COPD outcomes. This suggests it could be useful for prognosis and for managing emphysema progression in COPD.

(Bentaher et al., 2025) [19] Pulmonary emphysema is the main component of chronic obstructive pulmonary disease. It is a long-term inflammatory lung disease, and it shows up as reduced lung elasticity and poor gas exchange, mostly because the alveolar walls get destroyed. Cigarette smoking is the most common cause. Respiratory infections and environmental pollution can also contribute, both to how the disease starts and how it gets worse. The review covers risk factors, the mechanisms behind pathogenesis, experimental models that try to copy the human disease as closely as possible, and the treatments available now. At the end, it presents exploratory therapeutic approaches, based on evidence and personalized medicine, that aim to improve patient health.

(Shankar et al., 2024) [20] This study also aimed to check whether physiotherapy programmes can improve lung capacity and quality of life in people with these conditions, COPD and asthma. A total of 120 participants, aged forty to seventy-five, were randomly divided into two groups of sixty. The experimental group did twelve weeks of physical therapy, which included breathing exercises, airway clearance techniques and exercise training, while the control group did not. FEV1, FVC, 6MWT, the mMRC Dyspnea Scale and SGRQ scores were measured. The intervention group had a larger rise in FEV1 (15% vs. 5%, $p<0.01$) and FVC (12% vs. 3%, $p<0.01$). They also had a one-point drop in mMRC dyspnea score and a ten-point improvement in SGRQ. These results support the idea that specific physiotherapy may improve lung measures and quality of life in chronic respiratory disorders.

(Safei & Zulfahmidah, 2023) [21] Inspiratory muscle training (IMT) is a recommended pulmonary rehabilitation technique. It changes the type and distribution of muscle fibers, which raises lung capacity and helps exercise performance. How IMT affects COPD is still unclear, so this scoping review tried to find out. Out of 644 papers screened, nine IMT interventions met the inclusion criteria. Most of them reported improvements. Several facilitators and barriers appeared during implementation, and these decided whether an intervention succeeded or failed. Overall, IMT showed conflicting effects across COPD outcomes. Still, many studies suggest it can improve respiratory muscle function, dyspnea, quality of life, autonomic function, exercise tolerance, diaphragmatic strength, exertional dyspnea and balance.

(Grover, 2022) [22] A convincing indicator of lifespan is lung function. Elderly people are more vulnerable to disease processes due to several irreversible functional and anatomical changes that occur in the body as they age. Skeletal muscle dysfunction in the aged leads to age-related multifactorial health disorders such frailty, a recognized sign of chronic respiratory disease. The significance of pulmonary physiotherapy for older patients with chronic lung disease and other respiratory disorders is emphasized in this viewpoint essay. Dyspnea, exhaustion, reduced exercise tolerance, peripheral muscle dysfunction, and mental disorders are common symptoms that are commonly seen. A pulmonary rehabilitation program (PRP) addresses a person's symptoms, physical functioning, quality of life (QoL), hospitalization, and morbidity goals. A comprehensive, individualized assessment serves as the foundation for the prescription of pulmonary physiotherapy, a comprehensive patient-tailored intervention that includes exercise training, education, and lifestyle change. A multidisciplinary approach combined with a personalized and all-encompassing program can make the difference between leading a meaningful life and having pulmonary impairments.

(Sharaf et al., 2020) [23] to determine how patients with chronic obstructive pulmonary disease respond to pursed lip breathing exercises in terms of physiological parameters. Pursed lip breathing exercises enhance the physiological characteristics of patients with chronic obstructive pulmonary disease. This study was carried out at the Alexandria Main University Hospital's Chest Outpatient Clinic at Alexandria University in Egypt. Following pursed lip breathing exercise, the mean level of physiological parameters among the patients under study showed a high statistically significant improvement. Smoking behaviors and the level of physiological parameters following pursed lip breathing exercise were shown to be statistically significantly correlated. Suggestions: To help COPD patients improve their physiological parameters and enhance their quality of life, nurses should explain them the advantages of practicing pursed lip breathing exercises on a regular basis.

(Torres-Sánchez et al., 2017) [24] This analysis reviewed clinical studies comparing the efficacy of physiotherapy to conventional treatment, with a primary focus on the functional status of patients admitted for acute exacerbation of chronic obstructive pulmonary disease (AECOPD). The following were the requirements for study eligibility: (1) It was a clinical trial; (2) the subjects were adults with AECOPD; (3) one of the outcome measures was functional status, which is defined as an individual's ability to perform the normal daily activities required to meet basic needs, fulfilll usual roles, and maintain health and well-being; (4) it was written in English; (5) it was published between January 2009 and February 2016; and (7) the full-text article was available. Among patients hospitalized for AECOPD, a range of physiotherapy techniques have been demonstrated to enhance functional status when compared to conventional treatment; other outcome measures also demonstrated benefits.

DISCUSSION

The studies reviewed here point in a fairly consistent direction, though not with equal strength. Pulmonary physiotherapy in general has support. Torres-Sánchez et al. found that exercise, breathing exercises and chest therapy improved functional status in patients hospitalised for exacerbations, and Shankar et al. reported gains in FEV1, FVC and quality of life after twelve weeks of a structured programme. Grover also stresses that rehabilitation has to be personalised, especially in older people. For pursed-lip breathing, the evidence is more direct. Sharaf et al. recorded significant improvement in physiological parameters in COPD patients, which fits the mechanism of positive airway pressure during expiration. Respirometer training is harder to judge. The inspiratory muscle training review by Safei and Zulfahmidah showed mixed results, even if many outcomes improved, and nothing there tests Romson's device in emphysema itself. So its role stays supportive. Another gap is that most trials cover COPD as a whole, not emphysema alone. Curiale et al. and Bentaher et al. remind us that emphysema progresses unevenly and cannot be reversed, which is why symptom control matters.

CONCLUSION

Emphysema cannot be reversed, so management leans on making daily breathing easier. Respiratory physiotherapy fits that goal. Pursed-lip breathing is simple, needs no equipment, and has a clear physiological basis: it slows expiration, supports airway pressure and may cut down air trapping. Patients can use it while walking or climbing stairs once they have practised enough. Romson's respirometer offers visual feedback and encourages controlled inspiration, but forceful use can tire patients with severe breathlessness, so early sessions need supervision. Its value in emphysema is not yet proven, and it should not be treated as equal to incentive spirometry or dedicated inspiratory muscle training. Both methods work best inside a wider pulmonary rehabilitation programme tailored to the individual. Future research should test these techniques in emphysema-specific groups, using larger samples and longer follow-up, so clinicians have firmer evidence to rely on.

REFERENCES

[1] A. Rodrigues, G. M. Castro, C. Jácome, D. Langer, S. M. Parry, and C. Burtin, "Current developments and future directions in respiratory physiotherapy," Eur. Respir. Rev., vol. 29, pp. 1–13, 2020, doi: 10.1183/16000617.0264-2020.

[2] X.-H. Qi, H.-M. Ren, N. Wang, X.-P. Shi, X.-X. Wang, and Y. Wang, "Effects of respiratory muscle training on clinical outcomes in patients with chronic obstructive pulmonary disease: A systematic review and meta-analysis," Ann. Thorac. Meedicine, vol. 20, pp. 213–221, 2025, doi: 10.4103/atm.ATM.

[3] Tonika Tohri, Metilda, and Sindi Sugandi, "The Effect of Pursed Lip Breathing and Diaphragmatic Breathing on Increasing Oxygen Saturation in COPD Patients," J. Nurs. Pract., vol. 9, no. 1, pp. 89–94, 2025, doi: 10.30994/jnp.v9i1.965.

[4] C. Russian, S. Armstead, E. Rosenthal, and M. Shapiro, "Impact of respiratory muscle training on muscle strength, pulmonary function, symptoms, and quality of life in COPD," Can. J. Respir. Ther., vol. 61, pp. 262–271, 2025, doi: 10.29390/001c.146372.

[5] Vishnu K Nair, PSB Roshan, and Prathik, "Chest Physiotherapy for COPD Patients: A Case Series," Indian J. Physiother. Occup. Ther., vol. 19, no. 2, pp. 98–105, 2025, doi: 10.37506/bjezht72.

[6] M. D. M, M. Snehasri R, M. Vemburaja S, and M. Velarasu, "A Review on Emphysema Related to COPD," Int. J. Res. Trends Innov., vol. 8, no. 9, p. 407, 2023, [Online]. Available: www.ijrti.org

[7] S. Pathak, "Robotic Physiotherapy on Emphysema Patients: A Cross-Sectional Study," Int. J. Multidiscip. Res., vol. 6, no. 4, pp. 1–5, 2024, doi: 10.36948/ijfmr.2024.v06i04.25884.

[8] Rachna Singh, "A Quasi Experimental Study to Evaluate the Effectiveness Of Pursed Lip Breathing Exercise on Reduction of Dyspnea Among Chronic Obstructive Pulmonary Disease Patients in Selected Hospital in Panipat, Haryana," Int. J. Nurs. Educ., vol. 14, no. 4, pp. 65–72, 2022, doi: 10.37506/ijone.v14i4.18685.

[9] V. V. Deshmukh, S. J. Jadhav, N. Thul, and M. Muraleedharan, "Comparative Study Between Incentive Spirometry and Deep Breathing Exercises in COPD Patients," SN Compr. Clin. Med., vol. 8, no. 526, 2026, doi: 10.1007/s42399-026-02709-w.

[10] A. Babu, G. Kassahun, I. Dufour, D. Mandal, and D. Thuau, "Self-Learning e-Skin Respirometer for Pulmonary Disease Detection," Adv. Sens. Res., vol. 3, 2024.

[11] Tresia Fransiska Ulianna Tambunan, Moerdjajati Angka, Anita Ratnawati, and Zulkifi Amin, "Effects of Inspiratory Muscle Training with Incentive Spirometry to Maximum Inspiratory Capacity and Quality of Life on Chronic Obstructive Pulmonary Disease Patients," Indones. J. Phys. Med. Rehabil., vol. 2, pp. 55–63, 2013, doi: 10.36803/ijpmr.v2i01.227.

[12] R. Tripathi and A. Pramanik, "Effect of pursed-lip breathing on lung capacity and heart rate variability of healthy young adults.," Indian J. YOGA Exerc. Sport Sci. Phys. Educ., vol. 10, no. 1, pp. 59–67, 2025, doi: 10.58914/ijyesspe.2025-10.1.10.

[13] A. R. Roxy, D. P. Lakshmikanth, P. D. B. S. Kumar, and H. S, "The Effectiveness of Inspiratory Muscle Training and Aerobic Exercise in Improving Outcomes in Patients with Severe Chronic Obstructive Pulmonary Disease: A Case Series Study," J. Chem. Heal. Risks, vol. 16, no. 3, pp. 4976–4981, 2026.

[14] S. Sakhaei, H. E. Sadagheyani, S. Zinalpoor, A. K. Markani, and H. Motaarefi, "The Impact of Pursed-lips Breathing Maneuver on Cardiac, Respiratory, and Oxygenation Parameters in COPD Patients," Open Access Maced. J. Med.

Sci., vol. 6, no. 10, pp. 1851–1856, 2018, doi: 10.3889/oamjms.2018.407.

[15] Y. Xing, G. Hou, W. Li, Z. Wang, and L. Zhao, "Multi parameter respiratory training for pulmonary rehabilitation in AECOPD a randomized controlled trial," Sci. Rep., vol. 16, pp. 1–11, 2026, doi: 10.1038/s41598-026-50410-8.

[16] A. Dhengare and S. Pohekar, "Review Article on Pursed Lip Breathing Exercise," J. Res. Med. Dent. Sci., vol. 10, no. 5, pp. 101–102, 2022.

[17] Y. Yang et al., "The effects of pursed lip breathing combined with diaphragmatic breathing on pulmonary function and exercise capacity in patients with COPD: a systematic review and meta-analysis," Physiother. Theory Pract., vol. 38, no. 7, pp. 847–857, 2020, doi: 10.1080/09593985.2020.1805834.

[18] A. H. Curiale, C. Pistenmaa, R. San José Estépar, A. A. Diaz, G. Washko, and R. San José Estépar, "Emphysema progression risk in COPD using a localized foundational model of density evolution," npj Digit. Med., vol. 8, no. 1, pp. 1–12, 2025, doi: 10.1038/s41746-025-01917-3.

[19] A. Bentaher, O. Glehen, and G. Degobert, "Pulmonary Emphysema: Current Understanding of Disease Pathogenesis and Therapeutic Approaches," Biomedicines, vol. 13, no. 2120, pp. 1–37, 2025, doi: 10.3390/biomedicines13092120.

[20] D. C. M. Shankar, C. Varalakshmi, D. V Kiran, D. H. Gakhar, and D. H. Jani, "Exploring the Role of Physiotherapy in the Management of Respiratory Conditions: Techniques for Improving Pulmonary Function," African J. Biomed. Res., vol. 27, pp. 1744–1751, 2024, doi: 10.53555/ajbr.v27i3.4496.

[21] I. Safei and Z. Zulfahmidah, "Inspiratory Muscle Training in Chronic Obstructive Pulmonary Disease Patients: A Scoping Review," Green Med. J., vol. 5, pp. 84–99, Aug. 2023, doi: 10.33096/gmj.v5i2.144.

[22] S. Grover, "Challenges in physiotherapy of managing respiratory diseases in elderly population," Indian J. Tuberc., vol. 69, pp. S280–S286, 2022, doi: https://doi.org/10.1016/j.ijtb.2022.10.021.

[23] A. Y. Sharaf, M. A. Ghaleb, and R. F. Ahmed, "Effect of Pursed Lip Breathing Exercise on Physiological Parameters among Patients with Chronic Obstructive Pulmonary Disease," Int. J. Nov. Res. Healthc. Nurs., vol. 7, no. 1, pp. 21–27, 2020, doi: 10.47211/idcij.2020.v07i03.006.

[24] I. Torres-Sánchez, R. Cruz-Ramírez, I. Cabrera-Martos, A. Díaz-Pelegrina, and M. C. Valenza, "Results of Physiotherapy Treatments in Exacerbations of Chronic Obstructive Pulmonary Disease: A Systematic Review," Physiother. Canada, vol. 69, no. 2, pp. 122–132, 2017, doi: 10.3138/ptc.2015-78.