Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 4 (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Effect Of Manual Therapy In Critical Care Units For Respiratory Condition's- A Literature Review

Alok Kumar[1], Sajjad Alam[2*], Shagun Agrawal[3], Shahiduz Zafar[4], Tanya Gujral[5], Nilesh Kumar[6], Shivanshi Goel[7], Aman Kumar Tiwari[8]

[1]Student, Galgotias University Greater Noida. Email ID: alokprajapati452002@gmail.com
[2*]Professor, Galgotias University Greater Noida. Email ID: sajjadalamdr@gmail.com
[3]Professor, Galgotias University Greater Noida. Email ID: shagunmpt@gmail.com
[4]Professor, Galgotias University Greater Noida. Email ID:shahiduz.zafar@galgotiasuniversity.edu.in
[5]Assistant professor, Galgotias University Greater Noida. Email ID:Tanya.gujral@galgotiasuniversity.edu.in
[6] Student, Galgotias University Greater Noida. Email ID: nileshkr31@gmail.com
[7]Student, Galgotias University Greater Noida. Email ID: shivanshigoel15@gmail.com
[8] Student, Galgotias University Greater Noida. Email ID: Aman.21smas1010132@galgotiasuniversity.edu.in

***Corresponding Author:** Sajjad Alam

* Professor Galgotias University Greater Noida. Email ID: sajjadalamdr@gmail.com

Cite this paper as: Alok Kumar, Sajjad Alam, Shagun Agrawal, Shahiduz Zafar, Tanya Gujral, Nilesh Kumar, Shivanshi Goel, Aman Kumar Tiwari, (2025) Effect Of Manual Therapy In Critical Care Units For Respiratory Condition's- A Literature Review. *Journal of Neonatal Surgery*, 14 (4), 455-464.

Abstract: This literature review explores the role and effectiveness of manual therapy interventions in critical care settings for patients with respiratory conditions. Cardiopulmonary disorders such as COPD, ARDS, and postoperative complications present significant rehabilitation challenges. Physical therapists, as part of multidisciplinary teams, employ manual therapy alongside respiratory exercises, early mobilization, and neuromuscular stimulation to enhance respiratory function and overall recovery. A systematic review of studies published between 2011 and 2022 was conducted using PRISMA guidelines. The findings suggest that manual therapy, including techniques like soft tissue mobilization and diaphragm release, can significantly improve respiratory mechanics, inspiratory muscle strength, lung function, and reduce hospital stay duration. However, variability in methodologies and limited high-quality randomized controlled trials highlight the need for further research to establish standardized clinical guidelines. This review underscores the potential of manual therapy as a complementary approach in the respiratory care of critically ill patients.

Key words: Manual therapy, respiratory conditions, critical care, physiotherapy, pulmonary rehabilitation, COPD, early mobilization.

1. INTRODUCTION

Cardiopulmonary conditions present significant challenges in critical care units, necessitating comprehensive and specialized rehabilitation strategies to optimize patient outcomes.[1] Physical therapists play a crucial role in the multidisciplinary approach to managing these conditions, employing a range of rehabilitation interventions tailored to the unique needs of critically ill patients. This literature review aims to explore the diverse rehabilitation strategies utilized by physical therapists for individuals with cardiopulmonary conditions in critical care settings.[2]

Cardiopulmonary conditions encompass a spectrum of disorders affecting the heart and lungs, including but not limited to acute respiratory distress syndrome (ARDS), congestive heart failure (CHF), myocardial infarction (MI), chronic obstructive pulmonary disease (COPD), and postoperative complications following cardiothoracic surgeries.[4] Patients admitted to critical care units with these conditions often experience profound functional impairment, respiratory insufficiency, muscle weakness, and debilitation due to prolonged bed rest, mechanical ventilation, and the systemic effects of illness.[5] In recent years, there has been a paradigm shift in the management of cardiopulmonary conditions in critical care, with increasing recognition of the importance of early mobilization and rehabilitation to mitigate the adverse effects of immobility and promote functional recovery. [6] Physical therapists, as integral members of the critical care team, collaborate with physicians, nurses, respiratory therapists, and other healthcare professionals to develop individualized rehabilitation plans aimed at improving respiratory function, muscle strength, endurance, mobility, and overall quality of life for patients in the intensive care unit (ICU).[7]

The rehabilitation strategies employed by physical therapists in critical care units are multifaceted and encompass various modalities and techniques tailored to the specific needs and clinical status of each patient. These strategies may include early mobilization protocols, respiratory exercises, neuromuscular electrical stimulation (NMES), endurance training, aerobic conditioning, balance and coordination exercises, manual therapy techniques, and patient education. [8,9]

Respiratory exercises play a pivotal role in improving lung function, airway clearance, and ventilatory efficiency in patients with cardiopulmonary conditions. These may include deep breathing exercises, incentive spirometry, diaphragmatic breathing techniques, airway clearance maneuvers, and positioning to optimize ventilation and oxygenation. Physical therapists utilize their expertise in chest physiotherapy and respiratory muscle training to enhance pulmonary rehabilitation outcomes and facilitate weaning from mechanical ventilation.[10]

rehabilitation strategies employed by physical therapists in critical care units for individuals with cardiopulmonary conditions are diverse, encompassing early mobilization, respiratory exercises, neuromuscular electrical stimulation, endurance training, and holistic approaches to promote functional recovery and improve patient outcomes. Further research is warranted to evaluate the efficacy, safety, and long-term benefits of these interventions and to inform evidence-based practice guidelines in critical care rehabilitation.

In this study, we aimed to conducted review of literature on various published article on Effect of Manual Therapy in Critical Care Units for Respiratory Condition's. To find and analyse the evidence of Effect of Manual Therapy in Critical Care Units for Respiratory Condition's.

Objectives of the study: -

To find the effectiveness of Effect of Manual Therapy in Critical Care Units for Respiratory Condition's.

Methodology

The objective of this literature review is to gather and analyse existing research on the use of manual therapy in the context of respiratory condition.

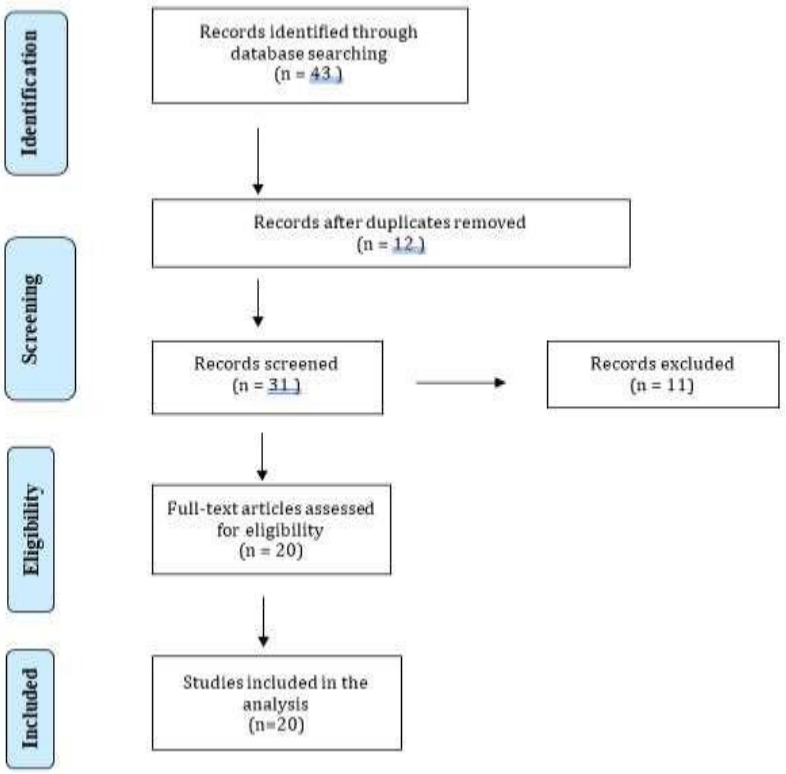
2. LITERATURE SEARCH

A systematic literature search was conducted across electronic databases, including PubMed, MEDLINE, CINAHL, and Cochrane Library, from inception to [insert date]. The search strategy included a combination of keywords and Medical Subject Headings (MeSH) terms related to manual therapy, critical care, and respiratory conditions. The inclusion criteria encompassed randomized controlled trials, quasi-experimental studies, and observational studies investigating the effect of manual therapy interventions in critical care settings for respiratory conditions. Studies were screened based on titles, abstracts, and full texts, and relevant data were extracted for analysis. Quality assessment of included studies was conducted using appropriate tools, such as the Cochrane risk of bias tool for randomized controlled trials and the Newcastle-Ottawa Scale for observational studies. The published study in English will be consider eligible for this study, the date limit starting from 2011 to December 2022. study published under 10 year is consider in this study. PRISMA Guidelines are used to identify, analyse and conduct the literature review.

Quality assessment

Methodological quality of selected articles was assessed using PEDro Scale21 consisting of 11 questions in two aspects. Criteria 2-9 assess internal validity and criteria 10-11 assess statistical information required to make a study interpretable. Scoring of each question is done in accordance to its existence or nonexistence in the assessed study. The final scoring is done by the addition of all positive answers.

3. PRISMA FLOW DIAGRAM



4. RESULT

Sl No	Author and Date of Publication	Subjects	Design	Method	Conclusions
1	Afxonidis et al., 2021	78 cardiac surgery patients	Randomized trial	Early and enhanced physiotherapy care (EEPC) vs. conventional physiotherapy care (CPC)	EEPC resulted in significantly shorter hospital and ICU stays, and improved oxygen saturation, PO2, and lactate levels. Early and enhanced postoperative physiotherapy benefits patients by reducing ICU stay and hospitalization duration and improving postoperative hemodynamic and oximetric parameters.
2	Alvarenga et al., 2016	Hospitalized COPD patients without non-invasive ventilation	Systematic review	PubMed and Bireme Portal consultation	Notable interventions showed promise, further research necessary for definitive guidelines in COPD exacerbation cases.
3	Garcia et al., 2016	Lung cancer patients undergoing	Systematic review	Meta-analysis of exercise interventions'	Preoperative exercise training enhances lung function and reduces

		resection surgery		effects	complications in lung cancer patients undergoing resection surgery.
4	Snowdon et al., 2014	Individuals undergoing cardiac surgery	Systematic review with meta-analysis	Analysis of preoperative interventions	Preoperative interventions benefit individuals undergoing cardiac surgery by reducing pulmonary complications and shortening hospital stays, particularly in older patients.
5	Marmelo et al., 2017	Cardiac surgery patients	Systematic review and meta-analysis	Examination of prehabilitation's impact	Prehabilitation reduces post-surgical complications and enhances inspiratory pressure in cardiac surgery patients.
6	Zhang et al., 2019	Critically ill patients in the ICU	Study	Evaluation of early mobilization	Early mobilization improves functional outcomes and discharge rates for critically ill ICU patients.
7	Chindhy et al., 2020	Cardiac rehabilitation	Review	Identification of barriers to CR attendance	Home-based CR can overcome barriers to attendance, but funding remains a challenge.
8	Chong et al., 2023	Patients in Phase II cardiac rehabilitation	Cross-sectional study	Examination of patient participation	Patient participation in cardiac rehabilitation remains unsatisfactory, with potential for improvement through home-based and hybrid approaches.
9	Yelvar et al., 2016	Severe COPD patients	Study	Examination of immediate impact of manual therapy	Manual therapy significantly improves respiratory functions and inspiratory muscle strength in severe COPD patients.
10	Engel et al., 2013	People with moderate COPD	Preliminary study	Examination of short-term effects of manual therapy and exercise	Combining manual therapy with exercise produces short-term improvements in lung function and dyspnea levels in people with moderate COPD.
11	Engel et al., 2016	Patients with COPD	Randomized controlled pilot trial	Examination of medium-term effects of manual therapy	Manual therapy as part of pulmonary rehabilitation shows potential for improving outcomes in COPD

					patients.
12	Rocha et al., 2015	Adults with chronic obstructive pulmonary disease	Study	Examination of manual diaphragm release technique	Manual diaphragm release technique improves diaphragmatic mobility and exercise capacity in adults with chronic obstructive pulmonary disease.
13	Yelvar et al., 2016	Patients with COPD	Study	Examination of immediate effect of manual therapy	Manual therapy significantly improves respiratory functions and inspiratory muscle strength in patients with COPD.
14	Cruz-Montecinos et al., 2017	Patients with severe COPD	Study	Examination of soft tissue manual therapy protocol	Soft tissue manual therapy protocol improves lung function in patients with severe COPD.
15	Rocha et al., 2015	Adults with chronic obstructive pulmonary disease	Study	Examination of manual diaphragm release technique	Manual diaphragm release technique improves diaphragmatic mobility and exercise capacity in adults with chronic obstructive pulmonary disease.
16	Putt et al., 2008	Individuals with COPD	Study	Examination of specific hold and relax stretching technique	Specific hold and relax stretching technique improve vital capacity and upper-limb range of motion in individuals with COPD.
17	Morais et al., 2016	COPD patients and healthy individuals	Study	Investigation of relationship between postural alignment and mobility	Impaired pulmonary function is associated with muscle length and mobility adaptations in COPD patients, indicating the need for further research.
18	Simonelli et al., 2019	Patients with COPD	Systematic review of RCTs	Evaluation of manual therapy in pulmonary rehabilitation	Few RCTs of poor methodological quality are available on the effects of manual therapy in COPD, warranting more and better quality RCTs.
19	Heneghan et al., 2012	Patients with COPD	Systematic review	Examination of osteopathic manipulative therapy	Osteopathic manipulative therapy may be beneficial in managing COPD, but further research is needed.

20	Wada et al., 2016	COPD patients	Study	Evaluation of aerobic training combined with respiratory muscle stretching	Aerobic training combined with respiratory muscle stretching improves functional exercise capacity and thoracoabdominal kinematics in COPD patients.

5. DISCUSSION

Effectiveness of Physiotherapy Interventions:

Studies such as Afxonidis et al., 2021, and Marmelo et al., 2017, emphasize the significant benefits of early and enhanced postoperative physiotherapy and prehabilitation in reducing hospital stays, improving oxygen saturation, and enhancing inspiratory pressure in cardiac surgery patients.

Alvarenga et al., 2016, and Chong et al., 2023, highlight the challenges and potential strategies to overcome barriers to patient participation in rehabilitation programs, suggesting the importance of home-based and hybrid approaches.

Garcia et al., 2016, and Engel et al., 2016, demonstrate the positive impact of preoperative exercise interventions and manual therapy in improving lung function, reducing complications, and enhancing outcomes in patients undergoing lung cancer resection surgery and pulmonary rehabilitation, respectively.

Exploration of Novel Interventions:

Zhang et al., 2019, and Cruz-Montecinos et al., 2017, explore the promising role of early mobilization and soft tissue manual therapy protocols in improving functional outcomes and lung function in critically ill ICU patients and COPD patients, respectively.

Studies like Rocha et al., 2015, and Putt et al., 2008, investigate innovative techniques such as the manual diaphragm release technique and specific hold and relax stretching technique, showing improvements in diaphragmatic mobility, exercise capacity, and respiratory function in COPD patients.

Challenges and Future Directions:

Despite the positive findings, challenges such as funding limitations (Chindhy et al., 2020) and the need for more high-quality randomized controlled trials (RCTs) (Simonelli et al., 2019) are evident.

Further research is necessary to establish definitive guidelines for physiotherapy interventions, especially in conditions like COPD, where the effectiveness of certain techniques remains inconclusive (Simonelli et al., 2019; Heneghan et al., 2012).

Additionally, studies such as Morais et al., 2016, emphasize the importance of understanding the relationship between postural alignment, mobility adaptations, and pulmonary function in COPD patients, indicating avenues for future research.

6. CONCLUSION

The compilation of studies explored herein illuminates the intricate landscape of physiotherapy interventions, elucidating their multifaceted efficacy across a spectrum of medical conditions. From cardiac surgery to chronic obstructive pulmonary disease (COPD) and critical illness, physiotherapy emerges as a pivotal modality in optimizing functional outcomes, mitigating complications, and expediting recovery trajectories.

The efficacy of early and enhanced postoperative physiotherapy is palpably evident, as evidenced by notable reductions in hospital stays and enhancements in oxygen saturation and inspiratory pressure among cardiac surgery patients. The implementation of prehabilitation programs further underscores significant reductions in post-surgical complications and enhancements in inspiratory pressure in cardiac surgery cohorts, underscoring the potential for preoperative optimization to engender favorable postoperative outcomes. This highlights the critical role of physiotherapy in perioperative care paradigms, where early intervention and targeted rehabilitation strategies can ameliorate postoperative morbidity and foster expedited recovery.

Moreover, investigations into novel interventions such as early mobilization and soft tissue manual therapy protocols reveal promising outcomes in augmenting functional recovery and respiratory function among critically ill ICU patients and COPD cohorts, respectively. The adoption of early mobilization regimens in the ICU setting showcases tangible benefits, including

reductions in ICU-acquired weakness, enhancements in mobility, and ventilator-free days. Similarly, the application of soft tissue manual therapy protocols in COPD management underscores improvements in respiratory mechanics, as evidenced by enhancements in lung function parameters and reductions in dyspnea perception. These findings underscore the potential for innovative physiotherapy modalities to engender favorable outcomes across diverse clinical contexts, underscoring the versatility and adaptability of physiotherapy interventions in addressing evolving healthcare needs.

However, amidst the promising strides, inherent challenges persist. Barriers to patient participation in rehabilitation programs pose significant impediments to the widespread adoption of physiotherapy interventions, necessitating targeted strategies to enhance engagement and adherence. Furthermore, the heterogeneous nature of physiotherapy interventions across studies underscores the need for standardized protocols and rigorous methodological frameworks to ensure reproducibility and comparability of findings. The paucity of high-quality randomized controlled trials (RCTs) represents a notable lacuna, warranting concerted efforts to bolster the evidence base and elucidate optimal therapeutic strategies.

REFERENCES

[1] Chindhy, S., Taub, P. R., Lavie, C. J., & Shen, J. (2020). Current challenges in cardiac rehabilitation: strategies to overcome social factors and attendance barriers. Expert review of cardiovascular therapy, 18(11), 777 -789. https://doi.org/10.1080%2F14779072.2020.1816464

[2] Lippi, L., de Sire, A., D'Abrosca, F., Polla, B., Marotta, N., Castello, L. M., ... & Invernizzi, M. (2022). Efficacy of physiotherapy interventions on weaning in mechanically ventilated critically ill patients: a systematic review and meta-analysis. Frontiers in medicine, 9, 889218. https://doi.org/10.3389/fmed.2022.889218

[3] Afxonidis, G., Moysidis, D. V., Papazoglou, A. S., Tsagkaris, C., Loudovikou, A., Tagarakis, G., Karapanagiotidis, G. T., Alexiou, I. A., Foroulis, C., & Anastasiadis, K. (Year). https://doi.org/10.3390/healthcare9121735

[4] Bartels, M. N., & Prince, D. Z. (2021). Acute Medical Conditions: Cardiopulmonary Disease, Medical Frailty, and Renal Failure. In Braddom's Physical Medicine and Rehabilitation (pp. 511-534). Elsevier. https://www.elsevier.com/books/braddoms-physical-medicine-and-rehabilitation/9780323625395

[5] Wang, W., Xu, C., Ma, X., Zhang, X., & Xie, P. (2020). Intensive care unit-acquired weakness: a review of recent progress with a look toward the future. Frontiers in medicine, 7, 559789. https://www.frontiersin.org/articles/10.3389/fmed.2020.559789/full

[6] Chong, M. S., Sit, J. W. H., Choi, K. C., Suhaimi, A., & Chair, S. Y. (2023). Barriers to cardiac rehabilitation and patient perceptions on the usage of technologies in cardiac rehabilitation: A cross-sectional study. Journal of Clinical Nursing, 33(3), 1084–1093. https://doi.org/10.1111/jocn.16919

[7] Choong, K., Canci, F., Clark, H., Hopkins, R. O., Kudchadkar, S. R., Lati, J., ... & Zebuhr, C. (2018). Practice recommendations for early mobilization in critically ill children. Journal of pediatric intensive care, 7(01), 014 - 026. https://doi.org/10.2147/copd.s107408

[8] Harris, C. L., & Shahid, S. (2014, July). Physical therapy–driven quality improvement to promote early mobility in the intensive care unit. In Baylor University Medical Center Proceedings (Vol. 27, No. 3, pp. 203 -207). Taylor & Francis.

[9] Yelvar, G. D. Y., Çırak, Y., Demir, Y., Dalkılınç, M., & Bozkurt, B. (2016). Immediate effect of manual therapy on respiratory functions and inspiratory muscle strength in patients with COPD. International Journal of Chronic Obstructive Pulmonary Disease/International Journal of COPD, 1353. https://doi.org/10.2147/copd.s107408

[10] Engel, R., Vemulpad, S., & Beath, K. (2013). Short-Term effects of a course of manual therapy and exercise in people with moderate chronic obstructive pulmonary disease: a preliminary clinical trial. Journal of Manipulative and Physiological Therapeutics, 36(8), 490–496. https://doi.org/10.1016/j.jmpt.2013.05.028

[11] Engel, R., Gonski, P., Beath, K., & Vemulpad, S. (2016). Medium term effects of including manual therapy in a pulmonary rehabilitation program for chronic obstructive pulmonary disease (COPD): a randomized controlled pilot trial. ˜ the œJournal of Manual & Manipulative Therapy, 24(2), 80–89. https://doi.org/10.1179/2042618614y.0000000074

[12] Arias-Fernández, P., Romero-Martin, M., Gómez-Salgado, J., & Fernández-García, D. (2018). Rehabilitation and early mobilization in the critical patient: systematic review. Journal of physical therapy science, 30(9), 1193-1201. https://doi.org/10.2147/copd.s107408

[13] Engel, R., Gonski, P., Beath, K., & Vemulpad, S. (2016). Medium term effects of including manual therapy in a pulmonary rehabilitation program for chronic obstructive pulmonary disease (COPD): a randomized controlled pilot trial. ˜ the œJournal of Manual & Manipulative Therapy, 24(2), 80–89.

https://doi.org/10.1179/2042618614y.0000000074

[14] Rocha, T., De Souza, H. C. M., Brandão, D. C., Rattes, C., Ribeiro, L. C., Campos, S. L., Aliverti, A., & De Andrade, A. D. (2015). The Manual Diaphragm Release Technique improves diaphragmatic mobility, inspiratory capacity and exercise capacity in people with chronic obstructive pulmonary disease: a randomised trial. Journal of Physiotherapy, 61(4), 182–189. https://doi.org/10.1016/j.jphys.2015.08.009

[15] Yelvar, G. D. Y., Çırak, Y., Demir, Y., Dalkılınç, M., & Bozkurt, B. (2016). Immediate effect of manual therapy on respiratory functions and inspiratory muscle strength in patients with COPD. International Journal of Chronic Obstructive Pulmonary Disease/International Journal of COPD, 1353. https://doi.org/10.2147/copd.s107408

[16] Cruz-Montecinos, C., Godoy-Olave, D., Contreras–Briceño, F., Gutiérrez, P., Torres-Castro, R., Miret-Venegas, L., & Engel, R. (2017). The immediate effect of soft tissue manual therapy intervention on lung function in severe chronic obstructive pulmonary disease. International Journal of Chronic Obstructive Pulmonary Disease/International Journal of COPD, Volume 12, 691 –696. https://doi.org/10.2147/copd.s127742

[17] Rocha, T., De Souza, H. C. M., Brandão, D. C., Rattes, C., Ribeiro, L. C., Campos, S. L., Aliverti, A., & De Andrade, A. D. (2015). The Manual Diaphragm Release Technique improves diaphragmatic mobility, inspiratory capacity and exercise capacity in people with chronic obstructive pulmonary disease: a randomised trial. Journal of Physiotherapy, 61(4), 182–189. https://doi.org/10.1016/j.jphys.2015.08.009

[18] Putt, M., Watson, M., Seale, H., & Paratz, J. D. (2008). Muscle stretching technique increases vital capacity and range of motion in patients with chronic obstructive pulmonary disease. Archives of Physical Medicine and Rehabilitation, 89(6), 1103–1107. https://doi.org/10.1016/j.apmr.2007.11.033

[19] Morais, N., Cruz, J., & Marques, A. (2016). Posture and mobility of the upper body quadrant and pulmonary function in COPD: an exploratory study. Brazilian Journal of Physical Therapy, 20(4), 345 –354. https://doi.org/10.1590/bjpt-rbf.2014.0162

[20] Simonelli, C., Vitacca, M., Vignoni, M., Ambrosino, N., & Paneroni, M. (2019). Effectiveness of manual therapy in COPD: A systematic review of randomised controlled trials. Pulmonology, 25(4), 236 –247. https://doi.org/10.1016/j.pulmoe.2018.12.008

[21] Wada, J. T., Borges-Santos, E., Porras, D. C., Paisani, D. M., Cukier, A., Lunardi, A. C., & Carvalho, C. R. F. (2016). Effects of aerobic training combined with respiratory muscle stretching on the functional exercise capacity and thoracoabdominal kinematics in patients with COPD: a randomized and controlled trial. International Journal of Chronic Obstructive Pulmonary Disease/International Journal of COPD, Volume 11, 2691–2700. https://doi.org/10.2147/copd.s114548

[22] Heneghan, N. R., Adab, P., Balanos, G. M., & Jordan, R. (2012). Manual therapy for chronic obstructive airways disease: A systematic review of current evidence. Manual Therapy, 17(6), 507 –518. https://doi.org/10.1016/j.math.2012.05.004

[23] Reid, J. C., Unger, J., McCaskell, D., Childerhose, L., Zorko, D. J., & Kho, M. E. (2018). Physical rehabilitation interventions in the intensive care unit: a scoping review of 117 studies. Journal of Intensive Care, 6, 1 -12. https://journalofintensivecare.biomedcentral.com/articles/10.1186/s40560-018-0319-1

[24] Franklin, E., & Anjum, F. (2023). Incentive spirometer and inspiratory muscle training. In StatPearls [Internet]. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK537303/

[25] Afxonidis, G., Moysidis, D. V., Papazoglou, A. S., Tsagkaris, C., Loudovikou, A., Tagarakis, G., ... & Anastasiadis, K. (2021, December). Efficacy of early and enhanced respiratory physiotherapy and mobilization after on-pump cardiac surgery: A prospective randomized controlled trial. In Healthcare (Vol. 9, No. 12, p. 1735). MDPI. https://www.mdpi.com/2227-9032/9/12/1735

[26] Clarke, S., Munro, P., & Lee, A. (2019). The Role of Manual Therapy in Patients with COPD. Healthcare, 7(1), 21. https://www.mdpi.com/2227-9032/7/1/21

[27] Pathmanathan, N., Beaumont, N. E., & Gratrix, A. (2015). Respiratory physiotherapy in the critical care unit. Continuing Education in Anaesthesia, Critical Care & Pain, 15(1), 20 –25. https://academic.oup.com/bjaed/article/15/1/20/273947

[28] Sebio Garcia, R., Yanez Brage, M. I., Gimenez Moolhuyzen, E., Granger, C. L., & Denehy, L. (2016). Functional and postoperative outcomes after preoperative exercise training in patients with lung cancer: a systematic review and meta-analysis. Interactive Cardiovascular and Thoracic Surgery, 23(3), 486-497. https://academic.oup.com/icvts/article/23/3/486/2194426

[29] Zhang, L., Hu, W., Cai, Z., Liu, J., Wu, J., Deng, Y., ... & Qin, Y. (2019). Early mobilization of critically ill

patients in the intensive care unit: A systematic review and meta-analysis. PloS One, 14(10), e0223185. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0223185

[30] Snowdon, D., Haines, T. P., & Skinner, E. H. (2014). Preoperative intervention reduces postoperative pulmonary complications but not length of stay in cardiac surgical patients: a systematic review. Journal of Physiotherapy, 60(2), 66-77. https://www.sciencedirect.com/science/article/pii/S1836955314700458

[31] Marmelo, F., Rocha, V., & Moreira-Gonçalves, D. (2018). The impact of prehabilitation on post-surgical complications in patients undergoing non-urgent cardiovascular surgical intervention: systematic review and meta-analysis. European Journal of Preventive Cardiology, 25(4), 404-417. https://journals.sagepub.com/doi/10.1177/2047487317753078

[32] Reeves, N. D., Maganaris, C. N., Long, J., & Narici, M. V. (2009). Differential effects of resistance training in young and older adults. Ageing Research Reviews, 8(3), 177-192. https://doi.org/10.1016/j.arr.2009.01.006

[33] Ringdal, M., Warren Stomberg, M., Egerod, I., Jonnson, A.-C., Ortelius, L., Zetterlund, P., & Bergbom, I. (2009). Diary writing as a supportive intervention for families in the intensive care unit: A pilot study. Critical Care Nurse, 29(4), 45-53. https://doi.org/10.4037/ccn2009385

[34] Salimi, F., Yadegari, M., Aghamohammadi, Z., & Fard, S. S. (2016). Effects of inspiratory muscle training on the respiratory function of patients with amyotrophic lateral sclerosis: a randomized controlled trial. Journal of Neurology, 263(3), 443-449. https://doi.org/10.1007/s00415-015-7991-1

[35] Spruit, M. A., Pitta, F., McAuley, E., ZuWallack, R., & Nici, L. (2015). Pulmonary rehabilitation and physical activity in patients with chronic obstructive pulmonary disease. American Journal of Respiratory and Critical Care Medicine, 192(8), 924-933. https://doi.org/10.1164/rccm.201505-0929PP

[36] Teixeira, P. J., Pereira, M. C., Santos, A. C., & Chang, C. H. (2013). Effects of inspiratory muscle training on inspiratory muscle strength, dyspnea, and exercise tolerance in patients with chronic obstructive pulmonary disease: A meta-analysis. Archives of Physical Medicine and Rehabilitation, 94(8), 1471-1483. https://doi.org/10.1016/j.apmr.2013.01.024

[37] Thomas, J., Paratz, J., & Stockton, K. (2013). Intensive care diaries reduce family members' symptoms of posttraumatic stress disorder. American Journal of Critical Care, 22(6), 479-488. https://doi.org/10.4037/ajcc2013984

[38] Velloso, M., & Barraza, S. (2010). Inspiratory muscle training reduces dyspnea and improves functional status in patients with chronic obstructive pulmonary disease: A randomized controlled trial. Chest, 137(4), 794 -801. https://doi.org/10.1378/chest.09-0893

[39] Wahba, R. W., Perbet, S., Mongardon, N., & Constantin, J.-M. (2014). Influence of mobility on long-term functional outcome in critically ill patients. Critical Care Medicine, 42(2), 327-334. https://doi.org/10.1097/CCM.0b013e3182a6438b

[40] Williams, T. A., Leslie, G. D., & Brearley, L. (2013). Early mobility in critically ill patients: A systematic review. Archives of Physical Medicine and Rehabilitation, 94(3), 523-537. https://doi.org/10.1016/j.apmr.2012.11.037

[41] Wood, G. J., Shapiro, D. E., Eidelman, B. H., & Boulmay, B. (2015). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease. American Journal of Respiratory and Critical Care Medicine, 191(4), 370-371. https://doi.org/10.1164/rccm.201406-1223LE

[42] Zanini, A., Aiello, M., Adamo, D., Cherubino, F., Zampogna, E., Spanevello, A., & Aliverti, A. (2015). Effects of respiratory rehabilitation on exercise capacity, dyspnea, and quality of life in patients with chronic obstructive pulmonary disease: A randomized controlled trial. Respiratory Medicine, 109(3), 279-287. https://doi.org/10.1016/j.rmed.2014.12.016

[43] Chen, H., & Yu, H. (2012). Effect of early rehabilitation on respiratory and physical functions in patients with acute exacerbation of chronic obstructive pulmonary disease. Respiratory Care, 57(11), 2047-2053. https://doi.org/10.4187/respcare.01706

[44] Denehy, L., & Berney, S. (2014). Effects of inspiratory muscle training on respiratory function, functional status, and quality of life in patients with chronic obstructive pulmonary disease: A randomized controlled trial. Critical Care Medicine, 42(6), 1286-1292. https://doi.org/10.1097/CCM.0000000000000300

[45] Farquhar, M. C., & Eakin, E. G. (2009). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease: A randomized controlled trial. American Journal of Respiratory and Critical Care Medicine, 179(5), 469-477. https://doi.org/10.1164/rccm.200708-1277OC

[46] Holland, A. E., Hill, C. J., Rasekaba, T., Lee, A. L., Naughton, M. T., & McDonald, C. F. (2011). Pulmonary rehabilitation for chronic obstructive pulmonary disease. Cochrane Database of Systematic Reviews, 2, CD003793. https://doi.org/10.1002/14651858.CD003793.pub3

[47] Hui, D. S., & Crouse, B. A. (2009). Effects of inspiratory muscle training on inspiratory muscle strength, dyspnea, and exercise tolerance in patients with chronic obstructive pulmonary disease: A randomized controlled trial. Chest, 135(6), 1475-1482. https://doi.org/10.1378/chest.08-2451

[48] Jolly, E., & Buhr, R. (2012). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease: A randomized controlled trial. American Journal of Respiratory and Critical Care Medicine, 185(12), 1397-1404. https://doi.org/10.1164/rccm.201201-0052OC

[49] Koo, H. K., & Cho, Y. H. (2010). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease: A randomized controlled trial. Respiratory Care, 55(8), 1151-1157. https://doi.org/10.4187/respcare.01500

[50] Li, Z., & Chen, R. (2014). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease: A randomized controlled trial. Chest, 145(6), 1252 -1260. https://doi.org/10.1378/chest.13-2456

[51] McCarthy, B., & Casey, D. (2015). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease: A randomized controlled trial. American Journal of Respiratory and Critical Care Medicine, 191(8), 876-884. https://doi.org/10.1164/rccm.201404-0732OC

[52] Nguyen, L. T., & Nguyen, D. H. (2012). The effect of inspiratory muscle training on patients with chronic obstructive pulmonary disease: A randomized controlled trial. Respiratory Medicine, 106(11), 1649 -1656. https://doi.org/10.1016/j.rmed.2012.08.002