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# The Role of Cardiopulmonary Physical Therapy in Promoting Healthy Aging and Preventing Age-Related Respiratory Problems: A Systematic Review

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## ABSTRACT

*Background: Population aging is associated with progressive declines in cardiopulmonary function and an increased burden of chronic respiratory conditions, underscoring the need for effective strategies that support healthy aging and functional independence. Objective: To systematically synthesize current evidence on the role of cardiopulmonary physical therapy (CPT) in promoting healthy aging and preventing age-related respiratory problems in older adults. Methods: A systematic review with narrative synthesis was conducted in accordance with established systematic review principles. PubMed, Scopus, Web of Science, and CINAHL were searched for English-language studies published between January 2019 and December 2024. Eligible studies included adults aged ≥60 years who received CPT or pulmonary rehabilitation interventions, with outcomes related to respiratory function, exercise capacity, quality of life, or functional independence. Two reviewers independently screened studies, extracted data, and assessed risk of bias. Results: Ten studies involving at least 4,296 participants met the inclusion criteria, comprising randomized and non-randomized interventional studies, observational studies, and secondary evidence syntheses. CPT interventions were consistently associated with improvements in exercise capacity and health-related quality of life, while effects on respiratory function and preventive outcomes were mixed and dependent on intervention specificity. Overall certainty of evidence ranged from low to moderate, reflecting heterogeneity in study designs and predominantly moderate risk of bias. Conclusion: CPT appears to be a beneficial component of care for older adults, particularly for enhancing functional capacity and quality of life; however, evidence supporting direct preventive effects on age-related respiratory decline remains limited. Higher-quality, long-term studies are required to clarify the preventive role of CPT in healthy aging.*

***Keywords:*** cardiopulmonary physical therapy, pulmonary rehabilitation, healthy aging, elderly, respiratory function.

## INTRODUCTION

Population aging is a defining global demographic trend, accompanied by a rising burden of chronic non-communicable diseases, particularly cardiovascular and respiratory conditions. Age-related structural and physiological changes in the cardiopulmonary system—including reduced chest wall compliance, diminished respiratory muscle strength, impaired gas exchange, and vascular stiffening—contribute to progressive declines in functional capacity, increased symptom burden, and heightened vulnerability to respiratory morbidity in older adults (1,6). These changes are further compounded by multimorbidity, physical inactivity, and prolonged periods of immobility, resulting in reduced quality of life, increased hospitalization rates, and escalating healthcare utilization among the elderly population (2,7).

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Cardiopulmonary physical therapy (CPT), encompassing pulmonary rehabilitation and structured exercise-based interventions, is recognized as a cornerstone in the management of chronic respiratory and cardiovascular diseases. Existing evidence demonstrates that CPT improves exercise tolerance, respiratory efficiency, symptom control, and health-related quality of life in patients with established cardiopulmonary conditions, particularly chronic obstructive pulmonary disease (COPD) (7,14,15). In addition to physiological benefits, CPT integrates patient education, behavioral modification, and psychosocial support, thereby promoting long-term adherence to healthy lifestyles and self-management strategies (3). These attributes position CPT not only as a therapeutic modality but also as a preventive intervention with relevance to healthy aging trajectories.

Despite these established benefits, the role of CPT in preventing or mitigating age-related respiratory decline before advanced disease onset remains insufficiently synthesized. While some studies suggest that regular physical activity and targeted respiratory training may attenuate age-associated declines in pulmonary function (9,10), other investigations report inconsistent effects, particularly when non-specific exercise protocols are employed (9). Furthermore, emerging modalities such as telerehabilitation and digitally supported CPT have shown promise in maintaining functional gains among older adults, yet their integration into routine preventive strategies remains uneven and under-evaluated (15,18). This heterogeneity in interventions, outcomes, and study designs has contributed to fragmented evidence and uncertainty regarding the broader preventive potential of CPT in aging populations.

From a public health perspective, promoting healthy aging aligns directly with Sustainable Development Goal 3 (SDG 3), which emphasizes the reduction of premature mortality from non-communicable diseases and the promotion of well-being across the lifespan (2,4,5). Although CPT conceptually supports these aims by addressing modifiable risk factors such as physical inactivity, functional decline, and poor disease self-management, the extent to which current evidence substantiates CPT as a scalable, preventive, and equity-oriented strategy for older adults has not been comprehensively reviewed. Existing reviews often focus narrowly on disease-specific outcomes, acute rehabilitation, or post-hospitalization settings, with limited emphasis on prevention, healthy aging, or alignment with global health goals (7,15).

Given the rapid expansion of the aging population, the growing emphasis on preventive healthcare, and recent advances in CPT delivery models, a timely synthesis of the available evidence is warranted. A systematic evaluation of contemporary literature is needed to clarify what is known, identify inconsistencies, and delineate the potential role of CPT in promoting respiratory health, functional independence, and overall well-being among older adults.

Therefore, the objective of this systematic review is to synthesize and critically appraise the existing evidence on the role of cardiopulmonary physical therapy in promoting healthy aging and preventing age-related respiratory problems in older adults. Using a PICO framework, this review focuses on adults aged 60 years and older (Population), receiving cardiopulmonary physical therapy or pulmonary rehabilitation interventions (Intervention), compared with usual care or no structured CPT (Comparison), and evaluates outcomes related to respiratory function, exercise capacity, quality of life, functional independence, and healthcare utilization (Outcomes).

## NARRATIVE REVIEW METHODS

This study was conducted as a systematic review with narrative synthesis, designed to evaluate the role of cardiopulmonary physical therapy in promoting healthy aging and preventing age-related respiratory problems in older adults. The review followed established principles for systematic reviews to ensure transparency, reproducibility, and methodological rigor. A review protocol was developed a priori; however, the protocol was not registered in a public registry. No deviations from the predefined methodology occurred during the review process.

Eligibility criteria were defined using the PICO framework. The population of interest included older adults aged 60 years and above, irrespective of sex, living in community, outpatient, inpatient, or rehabilitation settings. Studies involving mixed-age populations were included if results for older adults were reported separately or if the mean age of participants was 60 years or older. The intervention of interest was cardiopulmonary physical therapy, including pulmonary rehabilitation, structured exercise-based cardiopulmonary programs, respiratory physiotherapy, and related supervised interventions aimed at improving cardiopulmonary health. Comparators included usual care, no intervention, or alternative non-cardiopulmonary rehabilitation approaches, where applicable. Outcomes of interest included respiratory function, exercise capacity, physical function, quality of life, functional independence, hospitalization-related outcomes, and overall cardiopulmonary fitness. Secondary outcomes included patient education, self-management, and preventive health indicators. Eligible study designs comprised randomized controlled trials, non-randomized interventional studies, observational studies (cross-sectional, cohort, and case–control), and systematic reviews that addressed cardiopulmonary physical therapy in older populations. Conference abstracts, editorials, letters to the editor, gray literature, non-peer-reviewed sources, and studies not reporting relevant outcomes were excluded. Only studies published in English within the previous five years were considered to ensure contemporary relevance.

A comprehensive literature search was conducted across four electronic databases: PubMed, Scopus, Web of Science, and CINAHL. The final search was completed in December 2024 and covered studies published from January 2019 onward. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords related to cardiopulmonary physical therapy, aging, and respiratory health. The complete search strategy for PubMed was as follows: (“pulmonary rehabilitation” OR “cardiopulmonary physical therapy” OR “respiratory physiotherapy”) AND (“elderly” OR “older adults” OR “aging”) AND (“respiratory function” OR “cardiopulmonary fitness” OR “quality of life” OR “exercise capacity”). Equivalent adaptations of this strategy were applied to the other databases. In addition, reference lists of included studies were manually screened to identify any relevant articles not captured through the electronic search.

All retrieved records were imported into a reference management software, and duplicate records were removed prior to screening. Title and abstract screening was performed independently by two reviewers to identify potentially eligible studies. Full-text articles were subsequently assessed independently by the same reviewers against the predefined eligibility criteria. Discrepancies at any stage of the screening process were resolved through discussion and consensus. When consensus could not be reached, a third reviewer was consulted. Inter-reviewer agreement was maintained through regular calibration meetings; however, statistical measures of agreement were not calculated.

Data extraction was carried out independently by two reviewers using a standardized data extraction form developed specifically for this review. Extracted information included author details, year of publication, country, study design, sample size, participant characteristics, intervention details, comparator characteristics, outcome measures, key findings, and follow-up duration where reported.

For systematic reviews included in the analysis, the primary focus, population, and main conclusions were extracted. Any discrepancies in extracted data were resolved through discussion and consensus. Authors of primary studies were not contacted for missing or unclear data.

The methodological quality and risk of bias of included studies were assessed independently by two reviewers using tools appropriate to study design. Randomized controlled trials were assessed using a domain-based risk-of-bias approach, observational studies were evaluated for selection, comparability, and outcome-related biases, and systematic reviews were appraised for methodological rigor and transparency. Disagreements in risk-of-bias judgments were resolved through consensus. The results of the risk-of-bias assessment were used to inform the interpretation of findings but were not used as exclusion criteria.

Given the heterogeneity in study designs, interventions, outcome measures, and reporting methods, quantitative meta-analysis was not performed. Instead, a structured narrative synthesis approach was employed. Studies were grouped according to intervention type, population characteristics, and outcome domains.

The direction and consistency of effects across studies were examined, and key themes related to respiratory health, physical function, quality of life, and preventive outcomes were identified. Greater interpretive weight was given to findings from studies with lower risk of bias and more robust designs. The overall certainty of evidence was assessed qualitatively based on study quality, consistency of findings, and directness of evidence.

Ethical approval was not required for this review, as it involved analysis of previously published data. The authors declare no conflicts of interest. No external funding was received for the conduct of this review. To support reproducibility, the study selection process, extracted data, and risk-of-bias assessments are available from the corresponding author upon reasonable request.

## RESULTS

The critical, human-centered role that cardiopulmonary physical therapy (CPT) plays in assisting older persons in aging with strength, independence, and dignity is highlighted in this systematic study. According to the analyzed research, CPT helps patients regain their everyday lives and does much more than simply increase physical stamina or breathing. CPT encourages people to take charge of their health by lowering the risk of hospitalization and complications via compassionate teaching, emotional support, and guided activities. The way older persons experience aging may be changed in a meaningful and long-lasting way via therapy that addresses typical issues, including decreased mobility, chronic diseases, and lifestyle variables.

Ensuring access to equitable, preventative, and sustainable health solutions is the goal of this strategy, which is in line with Sustainable Development Goal 3. In the end, organized CPT programs prove to be more than just therapeutic instruments; they are lifelines that provide senior citizens a more complete, independent existence along with a revitalized feeling of optimism and well-being.

*Table 1. Characteristics and key findings of studies included in the systematic review*

| Sr. no | Authors | Year | Population Number and Study Design | Findings |
|---|---|---|---|---|
| 1 | Cristina Flor-Rufino PhDPT, et al. | 2024 | 2102 total participants were included in RCTs (systematic review and meta-analysis) | NVS exercise did not show beneficial results on respiratory muscle strength, but some studies reported beneficial effects when specific protocols were included. |
| 2 | Ting Xiong, et al. | 2023 | Study involved exercise intervention in different chronic pulmonary diseases | Exercise rehabilitation programs including aerobic, moderate-intensity resistance training, and HIIT help alleviate symptoms in CRDs and improve muscle function and cardiovascular health. |
| 3 | Simona Maria Rabinca, et al. | 2023 | 400 case studies included in post-COVID-19 patients | Telerehabilitation with continuous supervision and evaluation plays an important role in neurology, musculoskeletal, and respiratory domains. |
| 4 | Rossijskij Zurnal G. M, et al. | 2023 | Review of literature from the past 10 years | CEPT is safe and valuable for elderly diagnostics. |
| 5 | Johhanes Burtscher, et al. | 2022 | n = 1443 (714 women); cross-sectional study | Physical activity slows age-related changes in pulmonary function. |
| 6 | Daniela Leitl, et al. | 2022 | RCTs and meta-analyses were included | Pulmonary rehabilitation is effective in COPD, and digital technologies may help maintain its effects. |
| 7 | Diego Nacarato, et al. | 2022 | Systematic review and meta-analysis of controlled trials | Telerehabilitation can be a good alternative when incorporated into respiratory rehabilitation, improving functional capacity, cardiorespiratory fitness, and quality of life in older adults. |
| 8 | Sun Xiaoyan, et al. | 2021 | 157 elderly participants with COPD assigned into two interventional groups | In addition to respiratory rehabilitation, rehab nursing improves quality of life, living ability, and satisfaction. |
| 9 | Flor A Umbacia Salas, et al. | 2020 | N = 100 patients in pulmonary rehabilitation; prospective, retrospective, observational, multicentric/monocentric, controlled, randomized, comparative studies included | Pulmonary rehabilitation in COPD has beneficial effects on exercise capacity and overall quality of life. |
| 10 | Soleimanifar M, et al. | 2020 | Narrative review | Physical therapy and pulmonary rehabilitation play an important role in COVID-19 patients and show clear signs of improvement. |

## DISCUSSION

The present systematic review synthesizes recent evidence on the role of cardiopulmonary physical therapy (CPT) in promoting healthy aging and preventing age-related respiratory problems in older adults. Overall, the findings indicate that CPT interventions—particularly structured pulmonary rehabilitation and exercise-based programs—are consistently associated with improvements in exercise capacity and health-related quality of life, with more variable effects observed for respiratory function and respiratory muscle strength. Evidence supporting preventive or healthy-aging outcomes is emerging but remains limited in scope and certainty.

Interpretation of these findings must be considered in light of the heterogeneity and methodological quality of the included studies. The evidence base comprised a mix of randomized and non-randomized interventions, observational studies, and secondary evidence syntheses, resulting in substantial variability in intervention content, duration, outcome measures, and populations studied. While several studies demonstrated favorable

functional and quality-of-life outcomes, the overall risk-of-bias profile was predominantly moderate, with only a minority of included studies judged to be at low risk of bias. Consequently, the certainty of evidence was rated as moderate for exercise capacity and quality-of-life outcomes, and low to moderate for respiratory function and preventive indicators. This variability supports cautious interpretation and precludes strong causal inferences.

The findings of this review are broadly consistent with prior systematic reviews and narrative syntheses that have established pulmonary rehabilitation as an effective intervention for improving functional capacity and quality of life in older adults with chronic respiratory diseases, particularly COPD (7,14,15). Recent meta-analytic evidence suggests that cardiopulmonary and cardiovascular telerehabilitation may also improve functional capacity and cardiorespiratory fitness in older populations, expanding the potential reach of CPT beyond traditional facility-based models (18). However, similar to the present review, earlier studies have reported mixed results regarding respiratory muscle strength, especially when non-specific or low-intensity exercise protocols are employed (9). These inconsistencies highlight the importance of intervention specificity and adequate training stimulus.

From a clinical perspective, the observed improvements in exercise capacity and quality of life are highly relevant, even in the absence of pooled effect size estimates. Functional gains of this nature are closely linked to preserved independence, reduced disability, and improved daily functioning in older adults, outcomes that are meaningful to both patients and healthcare systems. Although direct evidence on reduced hospitalization or disease incidence was limited, improvements in functional reserve and physical activity levels may plausibly translate into downstream reductions in morbidity and healthcare utilization, particularly when CPT is implemented as part of a preventive or maintenance strategy aligned with healthy aging goals (2,5). Subgroup differences across studies suggest that outcomes may depend on both population characteristics and intervention design. Studies focusing on older adults with established chronic respiratory disease tended to report more consistent benefits than those involving heterogeneous or mixed clinical populations. Similarly, interventions incorporating combined aerobic and resistance training, or targeted respiratory muscle training, appeared more likely to yield positive physiological and functional outcomes than generalized exercise alone (12). Potential mechanisms underlying these effects include improved ventilatory efficiency, enhanced peripheral muscle function, reduced systemic inflammation, and behavioral adaptations such as increased physical activity and self-management capacity (3,10).

Several limitations of the evidence base warrant consideration. Many studies were of short duration and lacked long-term follow-up, limiting conclusions about sustained benefits and true preventive effects. Outcome reporting was inconsistent, with limited use of standardized measures for respiratory function or healthy-aging indicators. In addition, older adults with significant comorbidities or frailty were underrepresented, potentially limiting generalizability to the broader aging population.

Limitations of the review process should also be acknowledged. The search was restricted to English-language publications and a five-year publication window, which may have resulted in the omission of relevant earlier studies. Grey literature and unpublished data were not included, increasing the possibility of publication bias. Although duplicate screening and data extraction were performed, formal quantitative synthesis and statistical assessment of heterogeneity or small-study effects were not feasible due to clinical and methodological diversity across studies. Finally, the inclusion of secondary evidence (systematic and narrative reviews) alongside primary studies may have introduced overlap in underlying data. Future

research should prioritize well-designed randomized controlled trials evaluating CPT as a preventive intervention in older adults, including those without advanced cardiopulmonary disease. Standardization of intervention protocols and outcome measures—particularly for respiratory function, physical resilience, and long-term health trajectories—would enhance comparability across studies. Longitudinal studies examining sustained effects, healthcare utilization, and cost-effectiveness are also needed to better inform policy and practice. Additionally, further evaluation of telerehabilitation and hybrid delivery models may support more equitable and scalable implementation of CPT in aging populations. Collectively, such efforts would strengthen the evidence base and clarify the role of cardiopulmonary physical therapy in advancing healthy aging and aligned public health goals.

## CONCLUSION

In conclusion, this systematic review indicates that cardiopulmonary physical therapy is consistently associated with improvements in exercise capacity and health-related quality of life among older adults, while evidence for direct effects on respiratory function and preventive outcomes remains variable and of lower certainty. The findings support CPT as a beneficial component of care for aging populations, particularly when delivered through structured pulmonary rehabilitation and targeted exercise programs, but do not allow strong causal conclusions regarding disease prevention or long-term risk reduction. Clinically, the results underscore the value of CPT in maintaining functional independence and supporting healthy aging, especially for older individuals with or at risk of cardiopulmonary impairment. Future research should focus on high-quality, long-term randomized studies using standardized outcome measures to clarify the preventive potential of CPT and to inform scalable implementation strategies for diverse elderly populations.

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## DECLARATIONS

**Ethical Approval:** NA

**Informed Consent**: NA

**Authors' Contributions:**

Concept: HB; Design: HB; Data Collection: HB; Analysis: HB; Drafting: RS, MTM, HB, MH, NRK, MHd; Critical Review: HB; Final Approval: HB

**Conflict of Interest**: The authors declare no conflict of interest.

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**Study Registration:** Not applicable.