



CRITICAL MEDICAL AND SURGICAL NURSING JOURNAL

Vol. 14, no. 2, September 2025

Journal Homepage: <https://e-journal.unair.ac.id/CMSNJ>



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The Effectiveness of Nutritional Therapy in Patient with Chronic Obstructive Lung Disease: A Systematic Review of Randomized Controlled Trials

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ARTICLE HISTORY

Received: July 10, 2024

Accepted: September 26, 2025

KEYWORDS

Chronic Obstructive Lung Disease, nutrition, nutritional therapy,

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) is a leading cause of morbidity and mortality worldwide and is often complicated by malnutrition and muscle wasting, which adversely affect prognosis. Although nutritional therapy has been recommended as part of comprehensive COPD care, the effectiveness of recent interventions has not been systematically evaluated. This systematic review aimed to evaluate the impact of nutritional therapy on clinical, functional, and patient-centered outcomes in individuals with COPD.

Methods: Following the PRISMA guidelines, we searched Scopus, PubMed, EBSCO, and Nature for randomized controlled trials (RCTs) published between January 2020 and June 2025. Eligible studies included adult patients with COPD who received nutritional interventions. The risk of bias was assessed using the Cochrane RoB 2 tool. From 252 screened records, 13 RCTs involving 2,962 participants were included. Given the heterogeneity across interventions and outcomes, the findings were synthesized narratively.

Results: The interventions included oral nutritional supplements, high-energy formulas, individualized dietary counseling, vitamin D, ω -3 fatty acids, and multi-nutrient combinations. Seven studies reported significant improvements in quality of life, six demonstrated gains in weight and nutritional status, and three showed increased muscle strength. Two trials observed enhanced physical activity, whereas both vitamin D studies found no overall protective effect against exacerbations, except in patients with severe deficiencies. The risk of bias was low in eight studies and raised concerns in five. Overall, the strength of evidence was moderate, limited by heterogeneity, and inconsistent outcome reporting.

Conclusion: Nutritional therapy improves nutritional status and selected clinical outcomes in patients with COPD. Standardized, adequately powered RCTs are warranted to establish optimal protocols and to confirm long-term benefits.

Cite this as:

Hasanudin, H., Arif, T., Authoria, N., Rachmah, A.S.Y., Tirmidzi, A. (2025). The Effectiveness of Nutritional Therapy in Patient with Chronic Obstructive Lung Disease: A Systematic Review of Randomized Controlled Trials. *Crit. Méd. Surgical. Nurs. J*, 14(2),73-83.

1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) currently affects more than 213.39 million people worldwide as of 2021, and its prevalence is expected to continue to increase in the coming years (Wang et al., 2025). COPD is a progressive respiratory disorder that impairs lung function, reduces quality of life, and increases mortality during exacerbations, thereby imposing a substantial burden on patients and healthcare systems. It is also associated with systemic manifestations such as muscle wasting, malnutrition, and chronic inflammation, which further accelerate disease progression and worsen clinical outcomes (Furulund et al., 2021; Hurst et al., 2020).

Malnutrition in patients with COPD has complex and multifactorial causes, including elevated resting energy expenditure due to increased respiratory muscle workload, systemic inflammation, reduced dietary intake associated with dyspnea and early satiety, and metabolic alterations that impair protein synthesis and muscle maintenance (Engelen et al., 2022). Both malnutrition and obesity have been associated with decreased pulmonary function compared to patients with ideal body weight (Mete et al. 2018). Given these detrimental effects, nutritional therapy has been incorporated as an essential component of comprehensive COPD management, with the objectives of improving nutritional status, preserving muscle mass, enhancing functional performance, and ultimately improving patients' quality of life (Ahmadi et al., 2020; Baggs et al., 2023). These associations between nutritional status and COPD raise the question of whether nutritional therapy has beneficial effects on the disease outcomes (Tang et al., 2022).

Recent meta-analyses published in 2025 have provided evidence that nutritional supplementation interventions can yield positive effects among patients with COPD, including improvements in lung function, exercise tolerance, reduction in exacerbation symptoms, and enhanced quality of life (J. Zeng et al., 2025; Y. Zeng et al., 2025). This review differs from previous studies by focusing exclusively on randomized controlled trials (RCTs) and synthesizing the most recent evidence published within the last five years, thereby providing a more robust and up-to-date assessment of nutritional therapy in patients with COPD. The findings of this review are expected to contribute to the development of nutritional guidelines for the optimal management and care of patients with COPD.

2. METHODS

Study Design

This was a systematic review of randomized controlled trials.

Search Strategy

A comprehensive literature search was performed in Scopus, PubMed, EBSCO, and Nature databases for

studies published between January 1, 2020, and June 10, 2025. The search combined controlled vocabulary (MeSH terms) and free-text keywords related to COPD and nutrition. The following Boolean string was used in PubMed and adapted for other databases: ("Chronic Obstructive Pulmonary Disease" OR "COPD" OR "emphysema") AND (nutrition OR "nutritional therapy" OR "diet" OR "dietary" OR "supplements") AND ("randomized controlled trial" OR "RCT"). The full search strategy is presented in Table 1. The search yielded 252 records: 48 from PubMed, 61 from Scopus, 6 from EBSCO, and 137 from Nature. All retrieved records were imported into Mendelay, and duplicates were removed.

Table 1. PICOS search terms.

Population	Chronic obstructive pulmonary disease OR COPD OR emphysema
Intervention	Nutritional AND therapy OR nutrition OR diet OR dietary OR supplements
Comparison	Not applicable
Outcomes	Not applicable
Study design	randomized controlled trial OR RCT

Study Selection

The inclusion criteria for this systematic review were as follows: (1) all patients included in the study met the diagnostic criteria of the Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) and had COPD; (2) patients were more than 20 years old with COPD; (3) nutrition interventions included nutrition counseling/advice or diet or tailored supplementation as standalone interventions without combination with other interventions; (4) full-text articles published; (5) randomized controlled trial (RCT) study design; (6) articles published in English language; and (7) study subjects were human.

The exclusion criteria were as follows: (1) patients who were not included in GOLD had COPD, (2) the intervention provided was not nutritional therapy or nutritional therapy but combined with other interventions, (3) the article was only an abstract, not a full-text article, or duplicate articles, (4) the research design was not an RCT, and (5) Language other than English.

Data collection and analysis

This systematic review was conducted according to the PRISMA 2020 guidelines (Page et al., 2021). This was done by searching for articles in electronic databases using previously compiled PICOS framework keywords. After obtaining research articles that match the topic, the researchers will select the articles based on the research title, abstract, and full text. Duplicate articles will be excluded. Four researchers (HSN, AR, AT, and NA) independently

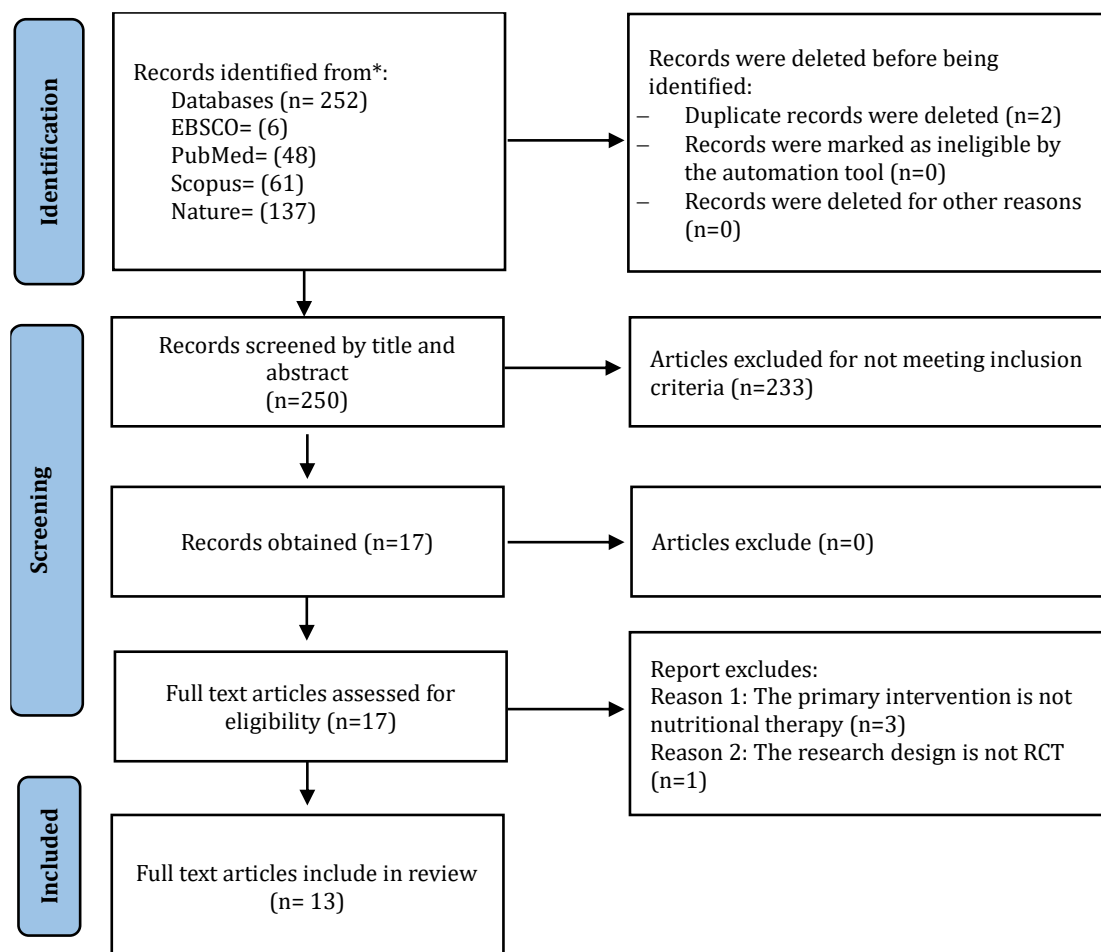


Figure 1. PRISMA 2020 flowchart for a new systematic review that includes searching databases, registers and other sources.

screened the results of the electronic eligibility search by screening the titles and abstracts. In the case of disagreement, the TA will be the mediator.

Figure 1 presents the study selection process in a flowchart, as recommended in the PRISMA statement, showing the total number of references retrieved and the number of studies included and excluded.

Data Extraction

Four researchers (HSN, AT, NA, and AR) independently extracted the article data as follows: (1) author and year, (2) country, (3) design, (4) sample, (5) intervention, (6) Duration of Intervention, and (7) Conclusion. Data extraction is presented in Table 2.

Risk of Bias

Four researchers (HSN, AR, AT, and NA) independently assessed the risk of bias of each study using the Cochrane RoB 2 tool. The domains assessed were as follows: (1) randomization process, (2) deviations from the intended interventions, (3) missing outcome data, (4) measurement of the outcome, and (5) selection of the reported result. Each study was rated as “low risk,” “some concerns,”

or “high risk” high risk. Disagreements were discussed with the TA and resolved.

3. RESULTS

Study Selection

A total of 252 articles were obtained during the database search that met the inclusion criteria. After excluding articles based on title, abstract, and full-text screening and duplicate removal, the final result was 13 potentially relevant articles that met the inclusion criteria were included in this systematic review. The results of the search for articles included in this systematic review are outlined in the PRISMA flowchart in Figure 1.

Risk of Bias Assessment

Risk of bias assessment in this systematic review using Cochrane RoB 2, of the 13 included articles, the majority of studies showed a low risk of bias, and although five studies showed some problems in specific domains, the overall risk of bias across the studies was considered acceptable. This suggests that the combined findings of these studies are methodologically robust and can be interpreted with moderate-to-high confidence. The risk of bias in the overall studies is presented in Table 3.

Study Characteristics

This systematic review included 13 articles from various countries, including Italy (n=1) (Radovanovic et al., 2025), Australia (n=1) (Conway et al., 2024), the United States (n=4) (Baggs et al., 2023) (Engelen et al., 2022) (Matheson et al., 2021) (Deutz et al., 2021), Belgium (n=1) (De Brandt et al., 2022), the Netherlands (n=2) (Rafiq et al., 2022) (van Beers et al., 2020), New Zealand (n=1) (Camargo et al., 2021), Iran (n=1) (Ahmadi et al., 2020), Vietnam (n=1) (Nguyen et al., 2020), and Spain (n=1) (Granados-Santiago et al., 2020). The total number of respondents in this systematic review was 2,962 patients with COPD. The characteristics of the patients in this study were: 1) Majority GOLD II-III (moderate-severe COPD) patients, 2) average age: 65-73 years old, and 3) most of the respondents had smoked.

Intervention

This systematic review summarizes some of the nutritional interventions provided to patients with COPD, including oral supplementation (n=2) (Radovanovic et al., 2025) (De Brandt et al., 2022), dietary counselling (n=5) (Conway et al., 2024) (Ahmadi et al., 2020) (Nguyen et al., 2020) (Granados-Santiago et al., 2020) (van Beers et al., 2020), Powdered Supplementation (n=1) (Conway et al., 2024), Nutrient-Dense Ready-To-Drink Liquid (n=3) (Baggs et al., 2023) (Matheson et al., 2021) (Deutz et al., 2021), Vitamin D (n=4) (Baggs et al., 2023) (Rafiq et al., 2022) (Camargo et al., 2021) (van Beers et al., 2020), ω -3 polyunsaturated fatty acid supplementation (n=2) (Engelen et al., 2022) (van Beers et al., 2020), and whey beverage fortification (n=1) (Ahmadi et al., 2020).

Intervention duration varied during hospitalization and for 90 days post-discharge (n=4) (Baggs et al., 2023) (Matheson et al., 2021) (Deutz et al., 2021) (Granados-Santiago et al., 2020), 4 weeks (n=2) (Radovanovic et al., 2025), (Engelen et al., 2022), 8 weeks (n=1) (Ahmadi et al., 2020), 12 weeks (n=3) (Conway et al., 2024), (Radovanovic et al., 2025) (De Brandt et al., 2022), 1 year (n=2) (Rafiq et al., 2022) (van Beers et al., 2020), and an average follow-up of 3.3 years (n=1) (Camargo et al., 2021).

Effects on functional outcomes: Seven studies found a significant improvement in the quality of life, as measured using instruments such as the Saint George's Respiratory Questionnaire (SGRQ) (n=3) (Conway et al., 2024) (Ahmadi et al., 2020) (Nguyen et al., 2020), Coughing Respiratory Questionnaire (CRQ) (n=1) (Radovanovic et al., 2025), Short-Form 36 Health Survey (SF-36) (n=1) (Baggs et al., 2023), and EuroQol-5D (n=2) (Granados-Santiago et al., 2020) (van Beers et al., 2020). Six studies found a significant improvement in Weight Gain and Nutritional Status (Conway et al., 2024) (Engelen et al., 2022) (Deutz et al., 2021) (Ahmadi et al., 2020) (Nguyen et al., 2020) (van Beers et al., 2020). Three studies showed an increase in muscle strength (Handgrip Strength) (Matheson et al., 2021) (Deutz et al., 2021). Two studies showed improvements in physical or

functional activity (van Beers et al., 2020) (Granados-Santiago et al., 2020). Two studies focusing on vitamin D showed the same main result, namely, no overall protective effect against exacerbations, except in the severely deficient subgroup (Rafiq et al., 2022) Camargo et al., (2021).

4. DISCUSSION

Malnutrition adversely affects several important clinical outcomes in patients with COPD. Approximately 30% of patients with COPD are malnourished, and the remaining 50% are at risk of malnutrition (Deng et al., 2023). Various problems that can arise in COPD patients who experience malnutrition include decreased lung function so that patients often experience dyspnea, low tolerance to physical activity, and decreased quality of life (Ruby, 2021). Therefore, health professionals play a crucial role in the early detection of nutritional problems and in educating patients on efforts to prevent and treat malnutrition, both in health facilities and at the community level (Mancin et al., 2024).

Nutritional management plays an important role in COPD management. Adequate nutritional intake can help improve the nutritional status and quality of life of patients with COPD (Zhang, 2025). Nutritional management interventions, such as providing health education, nutrition counselling, and supplementation, have been shown to help patients prevent weight loss and gradually improve the nutritional status of patients with COPD (Keogh & Mark Williams, 2021). These findings are supported by a systematic review showing that various types of interventions, including nutritional interventions, have the potential to benefit patients with COPD (Bell et al., 2024).

There was considerable heterogeneity across the included trials in terms of intervention type, duration, patient population, and outcome measures. Several studies have implemented oral supplementation (De Brandt et al., 2022; Radovanovic et al., 2025), while others have applied dietary counseling interventions (Conway et al., 2024), each assessing different outcomes, such as improvements in quality of life (Ahmadi et al., 2020), weight gain and nutritional status (Engelen et al., 2022), and muscle strength (handgrip strength) (Matheson et al., 2021). Previous trials evaluating vitamin D supplementation have reported no significant effects (Rafiq et al., 2022). The duration and frequency of the interventions also varied between the studies. Nevertheless, this review indicates that both dietary counseling and nutritional supplementation provide meaningful benefits for patients with COPD.

Nutritional therapy in patients with COPD can be provided while the patient is undergoing treatment in the hospital until the patient has finished treatment. Nutritional therapy provided while the patient is undergoing treatment in the hospital and provided for 3 months after the patient is discharged from the hospital has proven to be effective in improving the

quality of life, as well as helping the recovery of patients with COPD who experience malnutrition (Baggs et al., 2023; Matheson et al., 2021).

Nutritional therapy can be used as a standalone intervention or in combination with other interventions, such as respiratory rehabilitation. Research has shown that the combination of nutritional therapy and a pulmonary rehabilitation program is safe and effective in improving exercise capacity and maintaining body composition in patients with COPD who experience exacerbations (Oyama et al., 2024). The combination of individualized nutritional therapy with a pulmonary rehabilitation program conducted for 3 weeks was effective in increasing energy and protein intake and hand grip strength in patients with COPD at risk of malnutrition and sarcopenia (Coiro et al., 2025). Consistent high-intensity exercise in a pulmonary rehabilitation program is important, but patients must also pay attention to adequate energy intake and nutritional therapy so that body composition, nutritional status, physical function, and energy balance can be achieved in patients with COPD (Ikeuchi et al., 2025).

This evidence supports the integration of nutritional therapy as a core component of COPD management in patients with cachexia. Individualized dietary counseling and multi-nutrient supplementation appear particularly beneficial for malnourished patients, whereas routine vitamin D supplementation may not be warranted, except in those with proven deficiency. These findings suggest that tailoring nutritional strategies to patient profiles can optimize outcomes. This review has several limitations. First, the included RCTs varied in terms of intervention design, dosage, and follow-up duration, contributing to their heterogeneity. Second, some studies had small sample sizes, which limited their statistical power and generalizability. Third, the review was restricted to English-language publications, which may have introduced a language bias. Finally, publication bias cannot be ruled out, as studies with null results are less likely to be published.

5. CONCLUSION

This systematic review demonstrates that nutritional therapy offers clinically relevant benefits for patients with COPD, particularly through individualized dietary counseling and multi-nutrient supplementation, which are consistently associated with improvements in the quality of life, nutritional status, and muscle function. In contrast, vitamin D supplementation showed no significant effect on exacerbation prevention, except in severely deficient subgroups. The overall strength of evidence was moderate, constrained by heterogeneity in the interventions and the outcome reporting. Future large-scale multicenter RCTs with standardized protocols, longer follow-ups, and consistent outcome measures are needed to establish optimal nutritional

strategies and confirm their long-term impact on COPD management.

REFERENCE

- Ahmadi, A., Eftekhari, M. H., Mazloom, Z., Masoompour, M., Fararoei, M., Eskandari, M. H., Mehrabi, S., Bedeltavana, A., Famouri, M., Zare, M., Nasimi, N., & Sohrabi, Z. (2020). Fortified whey beverage for improving muscle mass in chronic obstructive pulmonary disease: A single-blind, randomized clinical trial. *Respiratory Research*, 21(1). <https://doi.org/10.1186/s12931-020-01466-1>
- Baggs, G. E., Middleton, C., Nelson, J. L., Pereira, S. L., Hegazi, R. M., Matarese, L., Matheson, E., Ziegler, T. R., Tappenden, K. A., & Deutz, N. (2023). Impact of a specialized oral nutritional supplement on quality of life in older adults following hospitalization: Post-hoc analysis of the NOURISH trial. *Clinical Nutrition*, 42(11), 2116–2123. <https://doi.org/10.1016/j.clnu.2023.09.004>
- Bell, K., Lawson, J., Penz, E., & Cammer, A. (2024). Systematic review of tailored dietary advice and dietitian involvement in the treatment of chronic obstructive pulmonary disease (COPD). In *Respiratory Medicine* (Vol. 225). W.B. Saunders Ltd. <https://doi.org/10.1016/j.rmed.2024.107584>
- Camargo, C. A., Toop, L., Sluyter, J., Lawes, C. M. M., Waayer, D., Khaw, K. T., Martineau, A. R., & Scragg, R. (2021). Effect of monthly vitamin d supplementation on preventing exacerbations of asthma or chronic obstructive pulmonary disease in older adults: Post hoc analysis of a randomized controlled trial. *Nutrients*, 13(2), 1–12. <https://doi.org/10.3390/nu13020521>
- Coiro, M., Zurfluh, A., Lehmann, U., Brun, P., Scheel-Sailer, A., Tschanz, H., van Hoof, A., Wilhelm, M., & Marcin, T. (2025). Effect of individual nutritional therapy during inpatient pulmonary rehabilitation in patients at risk for malnutrition and sarcopenia - a randomized controlled trial. *Chronic Respiratory Disease*, 22, 1–10. <https://doi.org/10.1177/1479973125135069>
- Conway, V., Hukins, C., Sharp, S., & Collins, P. F. (2024). Nutritional Support in Malnourished Outpatients with Chronic Obstructive Pulmonary Disease (COPD): A Randomized Controlled Pilot Study. *Nutrients*, 16(11). <https://doi.org/10.3390/nu16111696>
- De Brandt, J., Derave, W., Vandenabeele, F., Pomiès, P., Blanquaert, L., Keytsman, C., Barusso-Grüniger, M. S., de Lima, F. F., Hayot, M., Spruit, M. A., & Burtin, C. (2022). Efficacy of 12 weeks oral beta-alanine supplementation in patients with chronic obstructive pulmonary disease: a double-blind, randomized, placebo-controlled trial. *Journal of Cachexia, Sarcopenia and Muscle*,

- 13(5), 2361–2372.
<https://doi.org/10.1002/jcsm.13048>
- Deng, M., Lu, Y., Zhang, Q., Bian, Y., Zhou, X., & Hou, G. (2023). Global prevalence of malnutrition in patients with chronic obstructive pulmonary disease: Systemic review and meta-analysis. *Clinical Nutrition*, 42(6), 848–858.
<https://doi.org/10.1016/j.clnu.2023.04.005>
- Deutz, N. E., Ziegler, T. R., Matheson, E. M., Matarese, L. E., Tappenden, K. A., Baggs, G. E., Nelson, J. L., Luo, M., Hegazi, R., & Jonnalagadda, S. S. (2021). Reduced mortality risk in malnourished hospitalized older adult patients with COPD treated with a specialized oral nutritional supplement: Sub-group analysis of the NOURISH study. *Clinical Nutrition*, 40(3), 1388–1395.
<https://doi.org/10.1016/j.clnu.2020.08.031>
- Engelen, M. P., Jonker, R., Sulaiman, H., Fisk, H. L., Calder, P. C., & Deutz, N. E. (2022). ω -3 polyunsaturated fatty acid supplementation improves postabsorptive and prandial protein metabolism in patients with chronic obstructive pulmonary disease: a randomized clinical trial. *Am J Clin Nutr*, 116, 686–698.
- Furulund, E., Bemanian, M., Berggren, N., Madebo, T., Rivedal, S. H., Lid, T. G., & Fadnes, L. T. (2021). Effects of nutritional interventions in individuals with chronic obstructive lung disease: A systematic review of randomized controlled trials. In *International Journal of COPD* (Vol. 16, pp. 3145–3156). Dove Medical Press Ltd.
<https://doi.org/10.2147/COPD.S323736>
- Granados-Santiago, M., Valenza, M. C., López-López, L., Prados-Román, E., Rodríguez-Torres, J., & Cabrera-Martos, I. (2020). Shared decision-making and patient engagement program during acute exacerbation of COPD hospitalization: A randomized control trial. *Patient Education and Counseling*, 103(4), 702–708.
<https://doi.org/10.1016/j.pec.2019.12.004>
- Hurst, J. R., Skolnik, N., Hansen, G. J., Anzueto, A., Donaldson, G. C., Dransfield, M. T., & Varghese, P. (2020). Understanding the impact of chronic obstructive pulmonary disease exacerbations on patient health and quality of life. In *European Journal of Internal Medicine* (Vol. 73, pp. 1–6). Elsevier B.V.
<https://doi.org/10.1016/j.ejim.2019.12.014>
- Ikeuchi, T., Shingai, K., Ichiki, K., Jimi, T., Kawano, T., Kato, K., & Tsuda, T. (2025). Effects of exercise intensity on nutritional status, body composition, and energy balance in patients with COPD: a randomized controlled trial. *BMC Pulmonary Medicine*, 25(1), 34.
<https://doi.org/10.1186/s12890-024-03448-1>
- Keogh, E., & Mark Williams, E. (2021). Managing malnutrition in COPD: A review. *Respiratory Medicine*, 176(November 2020), 106248.
<https://doi.org/10.1016/j.rmed.2020.106248>
- Mancin, S., Khadhraoui, S., Starace, E., Cosmai, S., Petrelli, F., Sguanci, M., Cangelosi, G., & Mazzoleni, B. (2024). Prevention and Management of Malnutrition in Patients with Chronic Obstructive Pulmonary Disease: A Scoping Review. *Advances in Respiratory Medicine*, 92(5), 356–369.
<https://doi.org/10.3390/arm92050034>
- Matheson, E. M., Nelson, J. L., Baggs, G. E., Luo, M., & Deutz, N. E. (2021). Specialized oral nutritional supplement (ONS) improves handgrip strength in hospitalized, malnourished older patients with cardiovascular and pulmonary disease: A randomized clinical trial. *Clinical Nutrition*, 40(3), 844–849.
<https://doi.org/10.1016/j.clnu.2020.08.035>
- Mete, B., Pehlivan, E., Gülbaş, G., & Günen, H. (2018). Prevalence of malnutrition in COPD and its relationship with the parameters related to disease severity. *International Journal of COPD*, 13, 3307–3312.
<https://doi.org/10.2147/COPD.S179609>
- Nguyen, H. T., Pavey, T. G., Collins, P. F., Nguyen, N. V., Pham, T. D., & Gallegos, D. (2020). Effectiveness of Tailored Dietary Counseling in Treating Malnourished Outpatients with Chronic Obstructive Pulmonary Disease: A Randomized Controlled Trial. *Journal of the Academy of Nutrition and Dietetics*, 120(5), 778–791.e1.
<https://doi.org/10.1016/j.jand.2019.09.013>
- Oyama, Y., Tatsumi, H., Takikawa, H., Taniguchi, N., & Masuda, Y. (2024). Combined Effect of Early Nutrition Therapy and Rehabilitation for Patients with Chronic Obstructive Pulmonary Disease Exacerbation: A Prospective Randomized Controlled Trial. *Nutrients*, 16(5).
<https://doi.org/10.3390/nu16050739>
- Radovanovic, D., Signorello, J. C., Fuccia, G., Lazzaroni, G., Danzo, F., Guandalini, G. M., Massaro, F., Tursi, F., & Santus, P. (2025). Impact of L-arginine and liposomal vitamin C supplementation on quality of life and daily life activities in patients with COPD: a randomized, multicenter, single blind, placebo-controlled trial (ILDA study). *European Journal of Internal Medicine*.
<https://doi.org/10.1016/j.ejim.2025.04.039>
- Rafiq, R., Aleeva, F. E., Schrupf, J. A., Daniels, J. M., Bet, P. M., Boersma, W. G., Bresser, P., Spanbroek, M., Lips, P., van den Broek, T. J., Keijser, B. J. F., van der Ven, A. J. A. M., Hiemstra, P. S., den Heijer, M., de Jongh, R. T., den Heijer, M., de Jongh, R. T., Lips, P., Rafiq, R., ... Braunstahl, G. J. (2022). Vitamin D supplementation in chronic obstructive pulmonary disease patients with low serum vitamin D: a randomized controlled trial. *American Journal of Clinical Nutrition*, 116(2), 491–499.
<https://doi.org/10.1093/ajcn/nqac083>
- Ruby, D. (2021). Can the nutritional condition of chronic obstructive pulmonary disease patients influence the dyspnea severity and quality of

- life? *The Egyptian Journal of Chest Diseases and Tuberculosis*, 70(3), 363–368.
https://doi.org/10.4103/ecdt.ecdt_3_21
- Tang, X., Lei, J., Li, W., Peng, Y., Wang, C., Huang, K., & Yang, T. (2022). The Relationship Between BMI and Lung Function in Populations with Different Characteristics: A Cross-Sectional Study Based on the Enjoying Breathing Program in China. *International Journal of COPD*, 17, 2677–2692.
<https://doi.org/10.2147/COPD.S378247>
- van Beers, M., Rutten-van Mölken, M. P. M. H., van de Bool, C., Boland, M., Kremers, S. P. J., Franssen, F. M. E., van Helvoort, A., Gosker, H. R., Wouters, E. F., & Schols, A. M. W. J. (2020). Clinical outcome and cost-effectiveness of a 1-year nutritional intervention programme in COPD patients with low muscle mass: The randomized controlled NUTRAIN trial. *Clinical Nutrition*, 39(2), 405–413.
<https://doi.org/10.1016/j.clnu.2019.03.001>
- Wang, Z., Lin, J., Liang, L., Huang, F., Yao, X., Peng, K., Gao, Y., & Zheng, J. (2025). Global, regional, and national burden of chronic obstructive pulmonary disease and its attributable risk factors from 1990 to 2021: an analysis for the Global Burden of Disease Study 2021. *Respiratory Research*, 26(1), 2.
<https://doi.org/10.1186/s12931-024-03051-2>
- Zeng, J., Cheng, J., Zhu, L., & Tang, S. (2025). The effects of various nutritional supplements in patients with chronic obstructive pulmonary disease: a network meta-analysis. In *BMC Pulmonary Medicine* (Vol. 25, Issue 1). BioMed Central Ltd.
<https://doi.org/10.1186/s12890-025-03667-0>
- Zeng, Y., He, T., Ma, X., Guo, Q., & Zhang, J. (2025). Comparative Efficacy of Nutritional Supplements in Modulating Lung Function and Exercise Capacity in COPD Patients: A Network Meta-Analysis. *International Journal of Chronic Obstructive Pulmonary Disease*, 20, 1525–1541.
<https://doi.org/10.2147/COPD.S517252>
- Zhang, J. H. (2025). Effect of Nutritional Management on the Nutritional Status and Quality of Life of Patients with Chronic Obstructive Pulmonary Disease. *International Journal of COPD*, 20(February), 487–496.
<https://doi.org/10.2147/COPD.S494323>