International Journal of Chronic Obstructive Pulmonary Disease

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Effect of Nutritional Management on the Nutritional Status and Quality of Life of Patients with Chronic Obstructive Pulmonary Disease

Jian-Hui Zhang

Department of Respiratory and Critical Care Medicine, The First People's Hospital of Nantong City, Nantong, Jiangsu, 226000, People's Republic of China

Correspondence: Jian-Hui Zhang, Department of Respiratory and Critical Care Medicine, The First People's Hospital of Nantong City, No. 666, Shengli Road, Chongchuan District, Nantong, Jiangsu, 226000, People's Republic of China, Tel +86-0513-85061001, Email thetoez6222@21cn.com

Aim: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory condition characterized by airflow limitation, which often leads to malnutrition and reduced quality of life. This study aims to evaluate the effect of individualized nutritional management on the nutritional status, pulmonary function, and overall quality of life of patients with COPD.

Methods: This research is a retrospective analysis, and the patients were grouped according to the treatment methods. This study involved 100 patients with chronic obstructive pulmonary disease and were hospitalized at our hospital from March 2022 to March 2024. Among them, 43 patients with individualized nutritional management were classified as the observation group, 57 patients with regular dietary therapy management were classified as the control group. We collect clinical data on lung function, nutritional status, scores of quality of life, psychological state evaluation index, clinical efficacy, and diet satisfaction.

Results: The total effective rate of the observation group was 88.37%, which was higher than that of the control group (85.96%), and the differences were statistically significant ($P < 0.05$). The FEV1, FVC and FVE1% of the observation group were significantly higher than those of the control group after intervention (all $P < 0.05$). Moreover, after the intervention, the 6-Minute Walk Test (6MWT) distance increased, and COPD Assessment Test (CAT) scores decreased significantly in both groups, with the observation group showing greater improvements ($P < 0.05$).

Conclusion: Nutrition management has a remarkable clinical curative effect in treating COPD patients, which can improve their nutritional status and quality of life.

Keywords: nutritional management, nutritional status, quality of life, chronic obstructive pulmonary disease

Introduction

Chronic obstructive pulmonary disease (COPD) is a common and significant respiratory disorder with a high global prevalence.[1] It is estimated that a large number of people worldwide are affected by COPD.[2] COPD not only has a high morbidity but also brings a heavy burden to patients and society in terms of healthcare costs and reduced quality of life.[3] It often leads to frequent hospitalizations, limitations in physical activity, and impacts on daily life and work.[4,5] Smoking is a crucial risk factor.[6] Long-term and heavy smoking can cause significant damage to the airways and lungs, increasing the likelihood of developing COPD. Air pollution, such as exposure to particulate matter, harmful gases, and industrial pollutants, can also contribute to the occurrence of COPD.[7] Occupational exposures, for example, to dust, chemicals, and fumes in certain occupations, pose a risk.[8] Genetic factors play a role as well. Some people may have genetic predispositions that make them more susceptible to COPD.[9] In addition, low socioeconomic status and poor nutrition may also be associated with an increased risk of COPD.[10] The course of COPD is slow and progressively developing, and the lung function can show progressive decline, which seriously affects the patient's labor ability and quality of life in the later stage.

Received: 10 October 2024
Accepted: 5 February 2025
Published: 1 March 2025

Studies have shown that approximately one-third of hospitalized patients with chronic obstructive pulmonary disease (COPD) and one-fifth of outpatient patients have a risk of malnutrition.[11,12] Barbara Benedik et al[13] found that 68.5% of COPD patients have malnutrition. Thus, it can be seen that malnutrition is very common among COPD patients. Many COPD patients may have malnutrition or a risk of malnutrition. Due to the increased energy consumption caused by breathing difficulties and the body's hypermetabolic state, along with possible decreased food intake because of fatigue, shortness of breath during eating, and other factors, it can lead to insufficient intake of nutrients such as proteins, calories, and vitamins.[14] Some research has pointed out that malnutrition can reduce the quality of life of patients with chronic obstructive pulmonary disease, induce or even aggravate acute respiratory failure, and increase the occurrence of adverse respiratory events and cardiovascular events.[15]

Some research have pointed out that malnutrition is one of the independent risk factors for chronic obstructive pulmonary disease and sudden death.[16,17] Therefore, nutritional management plays an important role in chronic obstructive pulmonary disease. Proper nutrition helps to maintain the overall strength and energy levels of COPD patients.[18] Nutritional management refers to a comprehensive approach that includes dietary assessment, planning, and intervention to address malnutrition and support better health outcomes in COPD patients. Studies indicate that despite its recognized importance, there are challenges in the consistent application of nutritional management strategies in clinical practice, including symptom-related difficulties and a lack of standardized protocols.[19]

This study investigated the effect of nutritional management on the nutritional status and quality of life of patients with chronic obstructive pulmonary disease, aiming to improve the quality of life of COPD.

Data and Methods

The study was approved by the Ethics Committee of The First People's Hospital of Nantong City. Prior to participation, all eligible patients were informed about the study's purpose, procedures, potential risks, and benefits. Written informed consent was obtained from each participant before any study-related activities were conducted. Participants were assured of their right to withdraw from the study at any time without affecting their standard of care. All methods adhered to the ethical principles outlined in the Declaration of Helsinki and relevant institutional guidelines.

Clinical Data

This research is a retrospective analysis, and the patients were grouped according to the treatment methods. This study involved 100 patients with chronic obstructive pulmonary disease and were hospitalized at our hospital from March 2022 to March 2024. Among them, 43 patients with individualized nutritional management were classified as the observation group, 57 patients with regular dietary therapy management were classified as the control group.

Sample size was calculated using G Power 3.1 based on an expected effect size of 0.5 (moderate effect size), a significance level (α) of 0.05, and a desired statistical power ($1-\beta$) of 0.80. Based on these parameters, a minimum of 40 participants per group was required to detect statistically significant differences. Considering a possible dropout rate of 10%, the final target sample size was set at 100 patients (43 in the observation group and 57 in the control group). Patients were recruited consecutively from the inpatient population of The First People's Hospital of Nantong City based on the inclusion and exclusion criteria outlined in the study design. The statistical power of the study was evaluated post hoc using G Power 3.1, yielding a power value of 0.85, indicating adequate power to detect significant differences between groups.

Inclusion and Exclusion Criteria

Inclusion criteria: (1) Age $\geq$ 18 years. (2) Meet the diagnostic criteria of the "Diagnostic Guidelines for chronic obstructive pulmonary disease in China (2018 Edition)".[20] (3) Patients unable to consume sufficient nutrients orally and requiring nasogastric or nasojejunal tube feeding initially during the study period. Patients who, under nutritional management, achieved partial or full recovery of oral intake capacity were included if they continued to meet other study criteria. (4) Patients with normal communication ability and cognitive function.

Exclusion criteria: (1) Patients in the acute exacerbation stage of chronic obstructive pulmonary disease (meeting the definition of acute exacerbation of chronic obstructive pulmonary disease (AECOPD) in the 2019 GOLD guidelines); (2)

Patients who have received hormone and enteral or parenteral nutritional support treatment within 4 weeks; (3) Patients with other chronic lung diseases such as bronchial asthma, bronchiectasis, and interstitial lung disease; (4) Patients with systemic wasting diseases such as malignant tumors, active tuberculosis, and chronic gastrointestinal diseases; (5) Heart failure; (6) Connective tissue diseases; (7) Severe liver and kidney dysfunction; (8) Patients with mental disorders.

Methods

The control group received regular nutritional management, focusing on enteral feeding through nasogastric or nasojejunal tubes. Patients were instructed that the diet for any supplemental oral intake, when permitted by their condition, should be easy to digest, light, low in salt, and low in fat.

The observation group received individualized nutritional management therapy based on the control group's approach. The Harris-Benedict formula was applied to calculate the patients' basal energy expenditure (BEE),[21] determining the required daily calorie intake (kcal). The target nutritional ratio comprised 20–30% protein, 20–30% fat, and 50–60% carbohydrates. To address cases of insufficient calorie intake, enteral nutrition fluids were provided when clinically necessary, either through continued tube feeding or gradual oral intake based on patient tolerance and medical assessment. The nutritional fluids included essential components such as water, casein, dietary fiber, minerals, vegetable oil, vitamins, and trace elements, maintaining a nutrient distribution of 16% protein, 35% fat, and 49% carbohydrates with an energy density of 1.5 kcal/mL. These fluids were administered in multiple fractional doses to optimize absorption and digestion. In parallel, one-on-one nutritional education sessions were conducted with patients and their families. Key topics included managing nasogastric feeding, recognizing clinical signs of malnutrition, and understanding the importance of ongoing monitoring of nutritional indicators. Patients and families were familiarized with the role of nutrition in rehabilitation, emphasizing a balanced diet and the significance of high-quality protein intake. Personalized nutritional plans were developed for each patient, supplemented by educational materials and model demonstrations to illustrate proper dietary practices. Regular communication and counseling sessions were conducted to foster patient confidence and enhance adherence to nutritional management strategies. Active family involvement and support were encouraged throughout the four-week treatment period.

Data Collection

The main observation indicators: lung function, nutritional status, and scores of quality of life. The forced vital capacity (FVC), forced expiratory volume in the first second (FEV1) and FEV1/FVC of the patients were detected by using a lung function detector to evaluate the lung function of the patients. Nutritional indicators are used to assess the nutritional status of patients before and 1 month after intervention. 2–3 mL of blood is collected on an empty stomach before intervention and 1 month after intervention respectively. After centrifugation at 3000 r/min and a radius of 3 cm, serum and plasma are separated, and the serum is taken. Enzyme-linked immunosorbent assay (ELISA) is used to determine: prealbumin (PA), albumin (ALB), hemoglobin (Hb) and transferrin (TRF). The quality of life (GQOL-74) scoring is applied as the survey tool to evaluate the quality of life of patients.[22] This scale includes four dimensions: physical state, psychological function, social function and material function. Each dimension is scored out of 100, and the higher the score, the better the quality of life.

The second observation indicators: sports endurance, psychology state evaluation index, clinical efficacy, and diet satisfaction. The patients in the two groups were evaluated by the degree of 6MWT and CAT scale, and 0 was no dyspnea; 1 point: there is shortness of breath when going up a gentle slope or walking fast; 2 points: walking speed is slower than that of peers; 3 points: stop to breathe after walking 100 m; 4 points: dyspnea, severely restricting the patient's life.[22] We used Hamilton Anxiety Scale (HAMA)[23] and Hamilton Depression Scale (HAMD)[24] to assess the anxiety and depression of the subjects. HAMA includes 14 items reflecting anxiety symptoms, mainly involving two kinds of factor structures: somatic anxiety and mental anxiety. The reliability coefficient r of the total score is 0.93. The higher the score, the more serious the anxiety state is. After the intervention, the diet satisfaction part in the quality of life questionnaire is utilized to assess the satisfaction degree of the patients.[24] The diet satisfaction questionnaire contains a total of 6 items, and these items adopt a scoring method from 1 to 4, with "1 = never, 2 = occasionally, 3 = sometimes, 4 = often". Jospe MR[25] verified that it has good internal consistency (Cronbach's alpha= 0.83) and construct validity

(KMO = 0.676, P < 0.01). Clinical efficacy: (1) Marked effect: The symptoms are significantly reduced, and the pulmonary function and motor function are significantly improved; (2) Effective: The symptoms are relieved to some extent, and the pulmonary function and motor function are improved; (3) Ineffective: The symptoms are not relieved, and the pulmonary function and motor function are not improved. The treatment effective rate = (marked effect + effective)/ total number of cases × 100%. MNA-SF9: There are a total of 6 items, with a total score of 0–14 points. The higher the score, the better the nutritional status is indicated.

Statistical Analysis

SPSS 25.0 statistical analysis software was adopted. Analyses were performed using Graph Pad Prism (Graph Pad Software Inc., CA, USA). The measurement data with normal distribution were expressed by x±s, and the independent sample *t*-test was used for inter-group comparison, and the paired sample *t*-test was used for intra-group comparison; the measurement data with skewed distribution was expressed by M (Q25–Q75), and the non-parametric Mann–Whitney *U*-test was used for inter-group comparison, and the Wilcoxon signed rank sum test was used for intra-group comparison. The count data were expressed by frequency and constituent ratio, and the chi-square test or continuity correction was used for inter-group comparison. P < 0.05 indicated that the difference had statistical significance.

Results

Comparison of Clinical Data Between the Two Groups

In this study, there was no significant difference in terms of age, gender, BMI, smoking, hypertension, diabetes, marital status, chronic emphysema separated, asthma, disease severity, GOLD Stage and coronary heart disease between the two groups (Table 1).

Table 1 Comparison of Clinical Data Between the Two Groups

	Observation Group (n = 43)	Control Group (n = 57)	t/χ^2	*P*
Age (years)	51.05±7.91	50.35±7.19	3.251	0.342
Sex			3.281	0.421
Male (n%)	32 (74.42%)	30 (52.63%)		
Female (n%)	11 (25.58%)	27 (47.37%)		
BMI	20.7±2.28	20.4±2.76	2.209	0.532
Smoking	33 (76.74%)	42 (73.68%)	2.363	0.551
Marital status			1.831	0.342
Married	11 (25.58%)	16 (28.07%)		
Single	14 (32.56%)	11 (19.30%)		
Divorced or separated	10 (23.26%)	12 (21.05%)		
Widowed	7 (16.28%)	13 (22.81%)		
Unknown/missing	1 (2.33%)	5 (8.77%)		
Chronic emphysema separated	14 (32.56%)	16 (28.07%)	2.762	0.693
Asthma	15 (34.88%)	20 (35.09%)	5.722	0.412
Disease severity GOLD Stage			6.171	0.137
A	7 (16.28%)	12 (21.05%)		
B	16 (37.21%)	20 (35.09%)		
C	14 (32.56%)	16 (28.07%)		
D	6 (13.95%)	9 (15.79%)		
Diabetes	16 (37.21%)	20 (35.09%)	0.841	0.387
Hypertension	15 (34.88%)	16 (28.07%)	0.247	0.619
Hyperlipidemia	14 (32.56%)	18 (31.58%)	0.406	0.528
Coronary heart disease	10 (23.26%)	12 (21.05%)	0.597	0.487

Comparison of Clinical Efficacy Between Two Groups

The total effective rate of the observation group was 88.37%, which was higher than that of the control group (85.96%); the differences were statistically significant (P < 0.05). In the observation group, the markedly effective rate was 55.81% (24 cases), the effective rate was 32.56% (14 cases), and the ineffective rate was 11.63% (5 cases); in the control group, the markedly effective rate was 42.11% (24 cases), the effective rate was 43.89% (24 cases), and the ineffective rate was 14.04% (8 cases) (Table 2).

Comparison of Negative Psychological Scores Between the Two Groups

After the intervention, the SAS and HAMA scores of both groups were lower than those before the intervention, and the improvement of the negative psychological score in the observation group was significantly better than that in the control group (P < 0.05) (Table 3).

Comparison of Lung Function Between the Two Groups

As shown in Table 4, the level of FEV1 in the observation group before intervention was(1.15±0.62)L, and that in the control group was (1.12±0.57)L; while the level of FEV1 in the observation group after intervention was (1.87±0.65)L, and that in the control group was (1.59±0.62)L, the level of FEV1 of two groups after intervention were higher than those before intervention, and there had statistical significance (P < 0.05). The level of FVC in the observation group before intervention was (2.23±0.76)L, and that in the control group was (2.16±0.68)L; while the level of FVC in the observation group after intervention was (2.96±0.62)L, and that in the control group was (2.56±0.56)L, the level of FVC were

Table 2 Comparison of Clinical Efficacy Between Two Groups

Group	Number of Cases	Markedly Effective	Effective	Ineffective	Total Effective Rate
Observation group	43	24 (55.81%)	14 (32.56%)	5 (11.63%)	38 (88.37%)
Control group	57	24 (42.11%)	25 (43.89%)	8 (14.04%)	49 (85.96%)
t	–	4.128	8.527	14.261	12.348
P	–	0.005	0.031	0.003	0.006

Table 3 Comparison of Negative Psychological Scores Between the Two Groups

	Time	Observation Group (n = 43)	Control Group (n = 57)	t	*P*
HAMA	Before intervention	13.37±2.10	13.19±2.01	0.523	0.096
	After intervention	7.63±2.35	10.09±2.42	5.784	0.003
	χ^2	24.921	5.785	–	–
	P	0.001	0.022	–	–
HAMD	Before intervention	12.67±2.37	12.31±2.09	0.545	0.272
	After intervention	6.31±2.89	9.39±2.32	6.325	0.002
	χ^2	16.915	7.154	–	–
	P	0.001	0.001	–	–

Table 4 Comparison of Lung Function Between the Two Groups

	Time	Observation Group (n = 43)	Control Group (n = 57)	t	*P*
FVC	Before intervention	2.23±0.76	2.16±0.68	0.389	0.705
	After intervention	2.96±0.62	2.56±0.56	2.256	0.025
FEV_1	Before intervention	1.15±0.62	1.12±0.57	0.135	0.895
	After intervention	1.87±0.65	1.59±0.62	2.697	0.035
FEV_1/FVC	Before intervention	56.63±5.64	58.07±5.62	0.189	0.845
	After intervention	75.23±6.35	70.12±6.38	3.745	0.002

Table 5 Comparison of Quality of Life Before and After Intervention Between the Two Groups

	Time	Observation Group (n = 43)	Control Group (n = 57)	t	*P*
Physical function	Before intervention	63.23±1.06	61.27±1.08	3.235	0.087
	After intervention	89.36±1.09	70.19±1.56	32.748	0.001
Psychological function	Before intervention	61.23±1.09	62.38±1.08	2.268	0.077
	After intervention	79.98±1.08	74.23±1.69	43.658	0.006
Social function	Before intervention	64.26±0.98	65.26±0.98	1.056	0.098
	After intervention	86.38±1.08	68.95±1.07	20.168	0.001
Material function	Before intervention	63.54±1.08	64.58±1.08	2.568	0.076
	After intervention	76.39±1.19	66.36±1.56	36.119	0.001

improved after intervention. The level of FEV1/FVC in the observation group before intervention was (56.63±5.64)%, and that in the control group was (58.07±5.62)%; while the level of FEV1/FVC in the observation group after intervention was (75.23±6.35)%, and that in the control group was (70.12±6.38)%, the level of FEV1/FVC of two groups after intervention were higher than those before intervention, and there had statistical significance ($P < 0.05$).

Comparison of Quality of Life Before and After Intervention Between the Two Groups

Compared with the control group, the observation group had higher scores of physical function (89.36±1.09 vs 70.19 ±1.56, $P = 0.001$), psychological function (79.98±1.08 vs 74.23±1.69, $P = 0.006$), social function (86.38±1.08 vs 68.95 ±1.07, $P = 0.001$), and material function (76.39±1.19 vs 66.36±1.56, $P = 0.001$) after intervention, and there had significant difference between two groups ($P < 0.05$) (Table 5).

Comparison of Exercise Endurance Between the Two Groups

There was no significant difference in the 6-Minute Walk Test (6MWT) distance and COPD Assessment Test (CAT) scores between the two groups before the intervention ($P > 0.05$). After the intervention, the 6MWT distance increased and CAT scores decreased significantly in both groups compared to baseline ($P < 0.05$). Furthermore, the observation group showed significantly better results, with longer 6MWT distances and lower CAT scores than the control group ($P < 0.05$; Figure 1).

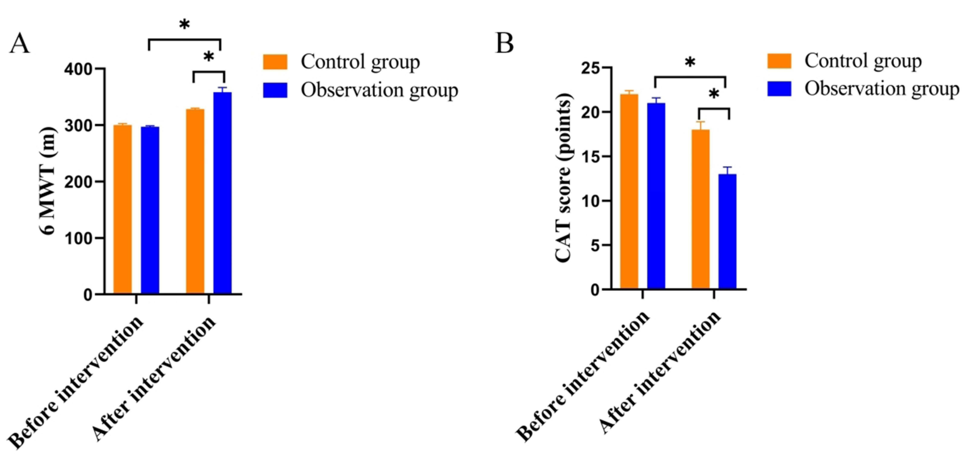

Figure 1 Comparison of exercise endurance between two groups. (**A**) 6MWT, (**B**) CAT.
Note: Compared to control group, $^*P < 0.05$.
Abbreviations: 6MWT, 6-minute walk test; CAT, COPD Assessment Test.

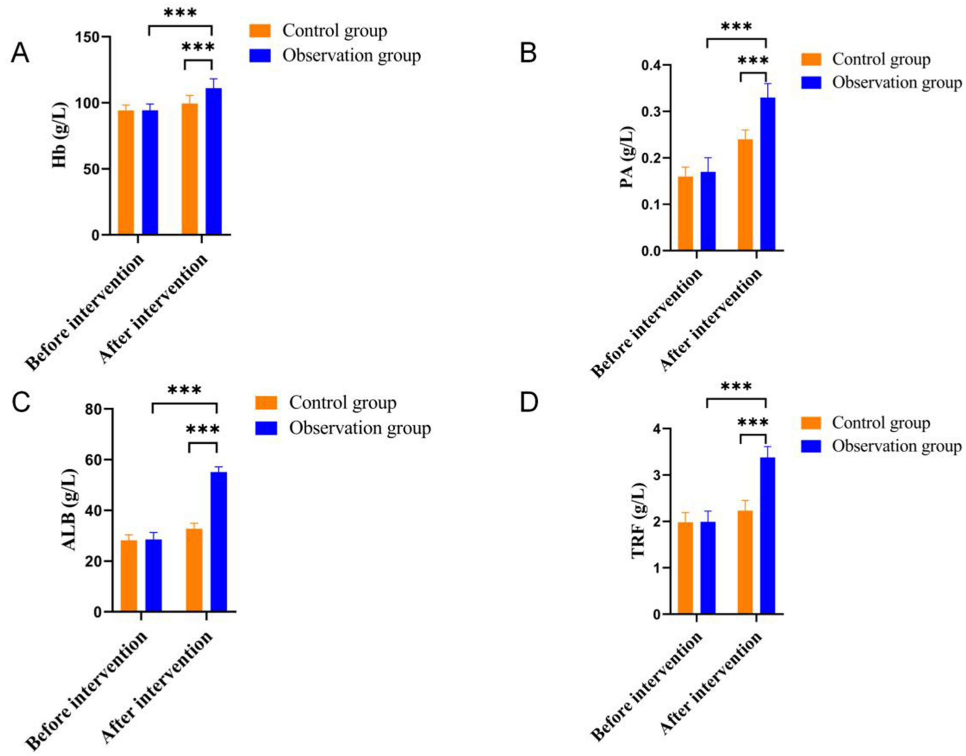

Figure 2 Comparison of nutritional status between two groups. (**A**) Hb, (**B**) PA, (**C**) ALB, (**D**) TRF.
Note: Compared to control group, ***P < 0.001.
Abbreviations: ALB, albumin; Hb, hemoglobin; PA, prealbumin; TRF, transferrin.

Comparison of Nutritional Status Between Two Groups

Before the intervention, there was no statistically significant difference in PA, ALB, Hb and TRF between the two groups of patients ($P > 0.05$). After the intervention, the PA, ALB, Hb and TRF of the patients in the observation group were significantly higher than those in the control group, and the difference was statistically significant ($P < 0.05$) (Figure 2).

Discussion

This study had suggested that nutritional management intervention had an obvious effect on patients with chronic obstructive pulmonary disease. The quality of life, nutritional status and lung function were ameliorated in the nutritional management group.

Due to the decreased pulmonary compliance and increased respiratory resistance in patients with COPD, excessive energy consumption is caused, and the nutritional demand is more obvious. However, the use of drugs such as glucocorticoids and the state of hypercapnia will affect the patient's appetite, resulting in insufficient nutritional intake, and thus malnutrition.[26] Malnutrition can also lead to a decrease in the patient's immune function and a reduction in the ability to resist respiratory tract pathogens, which is even more unfavorable to the prognosis of the disease.[27] In this study, we found that appropriate nutritional management interventions can effectively improve the clinical treatment efficiency, improving the lung function of patients. Proper nutrition plays a vital role in maintaining respiratory muscle function. COPD patients face increased respiratory muscle load due to the disease's nature, often leading to muscle depletion. Adequate protein intake provides essential amino acids required for the repair and maintenance of these muscles, improving their ability to contract and relax, thereby enhancing ventilation efficiency and alleviating breathing difficulties.[28] Furthermore, balanced nutrition supports immune function by providing essential nutrients such as proteins, vitamins (eg, Vitamin C, D), and trace elements (eg, zinc), which are crucial for enhancing the body's ability to combat respiratory pathogens. Improved immunity reduces the frequency and severity of exacerbations, directly benefiting lung health and overall disease prognosis.[29] A balanced diet provides essential nutrients that support the immune system.

A strong immune system is important for COPD patients to resist infections and reduce the occurrence and severity of exacerbations, which can have a positive impact on lung function.[30]

The results of this study show that nutritional management can significantly improve the nutritional status of COPD patients. Appropriate nutritional planning and guidance ensure that COPD patients obtain sufficient essential nutrients, such as proteins, carbohydrates, fats, vitamins, and minerals. Adequate protein intake helps maintain and repair muscle tissues, which is crucial for patients with potential muscle wasting.[31] Nutritional management ensures a well-balanced diet that meets the increased energy demands due to elevated respiratory workload in COPD patients. Adjusting macronutrient ratios—such as moderating carbohydrate intake to reduce carbon dioxide production—helps to optimize energy metabolism and alleviate respiratory strain. COPD patients often have increased energy consumption due to breathing difficulties and other factors. Tailoring the diet to meet their energy needs prevents further deterioration of their nutritional state.[32]

Interestingly, we found that appropriate nutritional management interventions can effectively improve the quality of life of COPD patients. Balanced nutrition can provide the necessary energy. These patients may experience shortness of breath and fatigue, and sufficient energy supply from a well-managed diet can help them better cope with daily activities and improve their physical function.[33] Nutritional management not only addresses physiological needs but also positively influences patients' mental well-being. Personalized dietary guidance combined with ongoing support empowers patients to make healthier food choices, enhancing their confidence and reducing disease-related anxiety and depression. Improved mental health contributes to better adherence to treatment regimens and lifestyle modifications.

Study Limitations

This study has certain limitations. First, the sample size was relatively small, and the research was conducted in a single-center hospital setting, which may limit the generalizability of the results. Second, the observation period was relatively short, lasting only four weeks, which does not allow for an assessment of the long-term effects of the intervention. Future large-scale, multi-center studies with extended follow-up periods are needed to validate our findings.

Conclusion

This study demonstrates that nutritional management interventions significantly improve the quality of life, nutritional status, and lung function of COPD patients. These findings suggest that incorporating nutritional management as part of a comprehensive treatment strategy may be particularly beneficial for patients experiencing malnutrition or requiring additional energy intake. In clinical practice, adopting nutritional management as a routine therapeutic approach could enhance treatment outcomes and overall patient well-being.

Abbreviations

COPD, Chronic Obstructive Pulmonary Disease; 6MWT, 6-Minute Walk Test; CAT, COPD Assessment Test; NGT, Nasogastric Tube; ALB, Albumin; CAT, COPD Assessment Test; COPD, Chronic Obstructive Pulmonary Disease; FEV1, Forced Expiratory Volume in 1 second; FVC, Forced Vital Capacity; HAMA, Hamilton Anxiety Scale; Hb, Hemoglobin; PA, Prealbumin; SAS, Self-Rating Anxiety Scale; TRF, Transferrin.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Christenson SA, Smith BM, Bafadhel M, Putcha N. Chronic obstructive pulmonary disease. *Lancet*. 2022;399(10342):2227–2242. doi:10.1016/S0140-6736(22)00470-6
2. Bhatt SP, Casaburi R, Agusti A, et al. Chronic obstructive pulmonary disease: hiding in plain sight, a statement from the COPD foundation medical and scientific advisory committee. *Lancet Respir Med*. 2023;11(12):1041–1043. doi:10.1016/S2213-2600(23)00436-8
3. Ding B, Small M, Holmgren U. A cross-sectional survey of current treatment and symptom burden of patients with COPD consulting for routine care according to GOLD 2014 classifications. *Int J Chron Obstruct Pulmon Dis*. 2017;12:1527–1537. doi:10.2147/COPD.S133793

4. Bamonti PM, Rose GA, Park S, Silberbogen AK, Moye J, Moy ML. Emotional distress and physical activity engagement in U.S. veterans with chronic obstructive pulmonary disease: a qualitative study. *Ann Behav Med*. 2024;58:539–551. doi:10.1093/abm/kaae030
5. Tabberer M, Williamson N, Tatlock S, et al. Qualitative interviews of patients with COPD and muscle weakness enrolled in a clinical trial evaluating a new anabolic treatment: patient perspectives of disease experience, trial participation and outcome assessments. *J Patient Rep Outcomes*. 2024;8(1):45. doi:10.1186/s41687-024-00712-0
6. Chen G, Mu Q, Meng ZJ. Cigarette smoking contributes to Th1/Th2 cell dysfunction via the cytokine milieu in chronic obstructive pulmonary disease. *Int J Chron Obstruct Pulmon Dis*. 2023;18:2027–2038. doi:10.2147/COPD.S426215
7. Kang J, Jung JY, Huh JY, Ji HW, Kim HC, Lee SW. Behavioral interventions to reduce particulate matter exposure in patients with COPD. *Medicine*. 2021;100(49):e28119. doi:10.1097/MD.0000000000028119
8. Silver SR, Alarcon WA, Li J. Incident chronic obstructive pulmonary disease associated with occupation, industry, and workplace exposures in the Health and Retirement Study. *Am J Ind Med*. 2021;64(1):26–38. doi:10.1002/ajim.23196
9. Adeloye D, Song P, Zhu Y, Campbell H, Sheikh A, Rudan I. Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. *Lancet Respir Med*. 2022;10(5):447–458. doi:10.1016/S2213-2600(21)00511-7
10. Yang IA, Jenkins CR, Salvi SS. Chronic obstructive pulmonary disease in never-smokers: risk factors, pathogenesis, and implications for prevention and treatment. *Lancet Respir Med*. 2022;10(5):497–511. doi:10.1016/S2213-2600(21)00506-3
11. Shen X, Qian R, Wei Y, et al. Prediction model and assessment of malnutrition in patients with stable chronic obstructive pulmonary disease. *Sci Rep*. 2024;14(1):6508. doi:10.1038/s41598-024-56747-2
12. Deng M, Lu Y, Zhang Q, Bian Y, Zhou X, Hou G. Global prevalence of malnutrition in patients with chronic obstructive pulmonary disease: systemic review and meta-analysis. *Clin Nutr*. 2023;42(6):848–858. doi:10.1016/j.clnu.2023.04.005
13. Mete B, Pehlivan E, Gülbaş G, Günen H. Prevalence of malnutrition in COPD and its relationship with the parameters related to disease severity. *Int J Chron Obstruct Pulmon Dis*. 2018;13:3307–3312. doi:10.2147/COPD.S179609
14. Bernardes S, Teixeira PJZ, Silva FM. Association of reduced BMI, length of hospital stay, mortality, and malnutrition diagnosis in patients with acute exacerbation COPD: a secondary analysis of a cohort study. *JPEN J Parenter Enteral Nutr*. 2023;47(1):101–108. doi:10.1002/jpen.2390
15. Wu X, Liu Z, Xu C, Plönes T, Wang H. The quality of life of patients with chronic obstructive pulmonary disease: a bibliometric analysis. *J Thorac Dis*. 2024;16(4):2591–2603. doi:10.21037/jtd-24-591
16. Dávalos-Yerovi V, Marco E, Sánchez-Rodríguez D, et al. Malnutrition according to GLIM criteria is associated with mortality and hospitalizations in rehabilitation patients with stable chronic obstructive pulmonary disease. *Nutrients*. 2021;13(2):369. doi:10.3390/nu13020369
17. Teixeira PP, Kowalski VH, Valduga K, de Araújo BE, Silva FM. Low muscle mass is a predictor of malnutrition and prolonged hospital stay in patients with acute exacerbation of chronic obstructive pulmonary disease: a longitudinal study. *JPEN J Parenter Enteral Nutr*. 2021;45(6):1221–1230. doi:10.1002/jpen.1998
18. van Beers M, Rutten-van Mölken MPMH, van de Bool C, et al. Clinical outcome and cost-effectiveness of a 1-year nutritional intervention programme in COPD patients with low muscle mass: the randomized controlled NUTRAIN trial. *Clin Nutr*. 2020;39(2):405–413. doi:10.1016/j.clnu.2019.03.001
19. Mouri T, Hatamochi C, Uchino J, Takayama K. Education program for male patients with chronic obstructive pulmonary disease to change dietary behavior. *Kobe J Med Sci*. 2020;66(3):E82–E89.
20. Cui Y, Dai Z, Luo L, Chen P, Chen Y. Classification and treatment of chronic obstructive pulmonary disease outpatients in China according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2017: comparison with GOLD 2014. *J Thorac Dis*. 2019;11(4):1303–1315. doi:10.21037/jtd.2019.03.99
21. Pavlidou E, Papadopoulou SK, Seroglou K, Giaginis C. Revised Harris-benedict equation: new human resting metabolic rate equation. *Metabolites*. 2023;13(2):189. doi:10.3390/metabo13020189
22. Bekelman DB, Feser W, Morgan B, et al. Nurse and social worker palliative telecare team and quality of life in patients with COPD, heart failure, or interstitial lung disease: the ADAPT randomized clinical trial. *JAMA*. 2024;331(3):212–223. doi:10.1001/jama.2023.24035
23. Tung VS, Thong NV, Mai NP, et al. Diagnostic value in screening severe depression of the Hamilton depression rating scale, Hamilton anxiety rating scale, beck depression inventory scale, and Zung's self-rating anxiety scale among patients with recurrent depression disorder. *Acta Inform Med*. 2023;31(4):249–253. doi:10.5455/aim.2023.31.249-253
24. Rabinowitz J, Williams JBW, Anderson A, et al. Consistency checks to improve measurement with the Hamilton Rating Scale for Depression (HAM-D). *J Affect Disord*. 2022;302:273–279. doi:10.1016/j.jad.2022.01.105
25. Jospe MR, Haszard JJ, Taylor RW, Freedhoff Y. A tool for assessing the satisfaction of a diet: development and preliminary validation of the diet satisfaction score. *Nutr Diet*. 2020;77(2):268–273. doi:10.1111/1747-0080.12591
26. Fekete M, Csípő T, Fazekas-Pongor V, et al. The possible role of food and diet in the quality of life in patients with COPD-A state-of-the-art review. *Nutrients*. 2023;15(18):3902. doi:10.3390/nu15183902
27. Tramontano A, Palange P. Nutritional state and COPD: effects on dyspnoea and exercise tolerance. *Nutrients*. 2023;15(7):1786. doi:10.3390/nu15071786
28. Hnatiak J, Galkova LZ, Winnige P, et al. Comprehensive home-based telerehabilitation in a morbidly obese male patient with severe obstructive sleep apnea. A case report. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub*. 2023;167(4):390–394. doi:10.5507/bp.2023.022
29. Pang X, Liu X. Immune dysregulation in chronic obstructive pulmonary disease. *Immunol Invest*. 2024;53(4):652–694. doi:10.1080/08820139.2024.2334296
30. Singh DN, Bohra JS, Dubey TP, et al. Common foods for boosting human immunity: a review. *Food Sci Nutr*. 2023;11(11):6761–6774. doi:10.1002/fsn3.3628
31. Heefner A, Simovic T, Mize K, Rodriguez-Miguelez P. The role of nutrition in the development and management of chronic obstructive pulmonary disease. *Nutrients*. 2024;16(8):1136. doi:10.3390/nu16081136
32. Beijers RJHCG, Steiner MC, Schols AMWJ. The role of diet and nutrition in the management of COPD. *Eur Respir Rev*. 2023;32(168):230003. doi:10.1183/16000617.0003-2023
33. Bell K, Lawson J, Penz E, Cammer A. Systematic review of tailored dietary advice and dietitian involvement in the treatment of chronic obstructive pulmonary disease (COPD). *Respir Med*. 2024;225:107584. doi:10.1016/j.rmed.2024.107584