# Role of Food in QoL of COPD Patients

Subjects: Respiratory System
Contributor: Mónika Fekete , Tamás Csípő , Vince Fazekas-Pongor , Madarász Bálint , Zoltán Csizmadia , Stefano Tarantini , János Tamás Varga , Monika Fekete

The diet has been described as a modifiable risk factor for the development and progression of chronic diseases, and emerging evidence increasingly highlights its preventive and therapeutic role in chronic obstructive pulmonary disease (COPD). While the association between underlying conditions such as metabolic disorders, obesity, diabetes, etc., and diet is natural, the direct impact is not as obvious in chronic obstructive pulmonary disease. The quality of poor nutrition and the development of nutrient deficiencies in respiratory diseases, including COPD, can be correlated with disease-specific factors such as worsening respiratory symptoms. These symptoms can be improved through dietary interventions, leading to positive changes in the pathogenesis of the disease and the quality of life for patients.

chronic obstructive pulmonary disease | nutritional intervention | protein | omega-3 polyunsaturated fatty acids

## 1. Introduction

Chronic obstructive pulmonary disease (COPD), characterized by persistent and generally progressive bronchial obstruction, represents a preventable and treatable public health problem [ 1 ]. COPD is a significant chronic illness with widespread prevalence, high mortality, and substantial long-term treatment costs [1, 2]. By 2020, it had become the third leading cause of death worldwide [ 1 , 2 ]. Severe COPD develops in 15-20% of chronic smokers, while the majority of smokers experience mild lung function impairment [ 3 ]. Current pharmacotherapy provides symptomatic relief but has limited impact on COPD progression [ 4 ]. The management of COPD involves a specialized healthcare team, including pulmonologists, respiratory rehabilitation experts, general practitioners, physiotherapists, psychologists, and dietitians. Patients with COPD may require a special diet based on their nutritional status, or dietary adjustments may be needed concerning nutrient composition and/or consistency [ 5 , 6 ]. The initiation of nutritional therapy is often necessary during acute COPD exacerbations, especially in undernourished patients [ 7 , 8 ].

While the connection between underlying conditions such as metabolic disorders, obesity, diabetes, etc., and diet is natural, the direct impact is not as evident in chronic respiratory diseases like COPD [ 9 , 10 ]. Nevertheless, a proper diet is an incredibly important element in the successful treatment of COPD. The positive effects of a nutritionally adequate diet become apparent even in COPD, considering malnutrition, undernutrition, or extreme overweight, all of which significantly impair respiration [ 9 , 10 ]. A suitable diet improves the quality of life and

slows down the progression of the disease, making patient education and dietary counseling essential in this chronic respiratory disease [ 11 ]. Furthermore, even with a normal BMI, there is a decrease in lean muscle mass (fat-free mass), negatively affecting respiratory muscle function in COPD [ 12 , 13 ]. This is further compounded by systemic chronic inflammation, physical inactivity, nutritional deficiencies (e.g., macro- and/or micronutrient deficiencies and protein deficiency), increased energy requirements due to infections, and the side effects of medications (e.g., corticosteroids) [14 -16 , 17 , 18 ].

Although COPD primarily manifests in the lungs, it is associated with extrapulmonary conditions such as cardiovascular diseases, osteoporosis, metabolic syndrome, anxiety, lung cancer, and depression. These comorbidities are highly prevalent in COPD, worsening the outcome of the disease, affecting patients' quality of life, and influencing the prognosis of the disease [ 19 , 20 ]. These observations support the pathological inflammatory reaction in the lungs, accompanied by systemic inflammation throughout the body, especially during acute exacerbations [ 14 , 21 , 22 ]. It has a significant impact on the cardiovascular system, metabolism, skeletal muscles, leading to the exacerbation of existing cardiovascular diseases, type 2 diabetes mellitus, hypertension, osteoporosis, deconditioning, undernutrition, muscle dysfunction, wasting, and depression [2 , 14 , 20 ]. Active smokers with COPD have been observed to have a poorer diet compared to those who have quit smoking [ 23 ], and active smokers also exhibit higher levels of oxidative stress. Oxidative stress can be reduced through dietary modifications, positively affecting the levels of inflammatory markers [ 10 ]. Considering that 70% of COPD patients have severe comorbidities, it can be assumed that either common risk factors (aging, smoking, reduced physical activity, dietary habits leading to obesity) play a role in comorbidity, or (less well-established at present) that the combination of individual diseases exerts a synergistic effect in exacerbating or even worsening harmful effects. As a result, the natural course of the disease accelerates, functional capacity decreases, breathing difficulties worsen, and, concomitantly, the quality of life deteriorates, increasing the risk of mortality [ 24 ].

## 2. The Role of Nutrition and Diet in the Quality of Life of COPD Patients

The study emphasizes several fundamental nutritional messages highlighted in previous research [ 5 , 9 , 10 , 11 , 12 , 25 , 26 , 27 , 28 , 29 ]. Specifically, it underscores the daily consumption of energy- and protein-rich foods, as well as omega-3 supplementation, to improve patients' nutritional status, exercise tolerance, and overall quality of life. It further emphasizes the significance of nutrition and a proper diet as a modifiable risk factor in the prevention and management of COPD. From this perspective, the dietary habits of patients require considerable attention. Results show that after various nutritional interventions, patients' respiratory function [ 30 , 34 ] and exercise capacity [ 40 , 42 , 47 , 50 ], improve, while airway inflammations [ 30 ] and systemic inflammatory parameters in the blood significantly decrease [ 42, 34 , 35 , 42 ], Moreover, exacerbations decrease [ 31, 52 ] and antioxidant capacity improves [ 30 , 33 , 42 , 43 ]. Previous studies [ 56 , 57 , 58 , 59 ], have also described these nutritional interventions as specifically recommended for COPD, as they enhance the strength of respiratory muscles, peripheral muscle strength, metabolism, and various measured clinical parameters simultaneously [ 37. , 38. , 39. , 40. , 56. , 57. , 58. , 59. ]. Additionally, an increase in body mass index reduces the risk of mortality [ 39 , 54 ],

improves quality of life [ 50 , 51 , 53 , 55 ], and reduces anxiety, depression [ 50 , 52 ] and breathlessness [ 40 , 55 ], all achieved without side effects and in a cost-effective manner.

The well-established connection between overall health, quality of life, and dietary habits is recognized. There are certain physical conditions and diseases for which an appropriate diet is easily accessible and has long been ingrained in common knowledge. However, there are diseases for which the related dietary literature is less extensive, and COPD falls into the latter category. The quality of life of COPD patients can be improved with proper dietary interventions; the progression of the disease can be significantly slowed down, and symptoms can be alleviated with appropriate, personalized therapy and lifestyle changes. Proper nutrition represents a kind of balance, meaning that the body needs to consume sufficient energy, protein, vitamins, and minerals [ 60 , 61 , 62 ]. Considering that severe COPD is characterized by impaired gas exchange, carbon dioxide production, i.e., carbohydrate intake, should be limited. The respiratory quotient (RQ) should be taken into account in the calorie source: if fats (RQ = 1) are provided, less CO2 is generated compared to glucose at the same calorie amount (RQ = 0.7). The recommended nutrient ratios, emphasizing reduced carbohydrate intake to facilitate respiratory work, are as follows: 35-40% of energy from fats, 40-45% from carbohydrates, and 1.2-1.5 g/kg protein intake relative to body weight (energy percentage) [ 63 ]. Consuming less energy than needed leads to weight loss and weakening of respiratory muscles, causing breathing difficulties, which lead to loss of appetite, further weight loss, and ultimately a vicious circle [ 64 , 65 ]. Moreover, reduced appetite is a common issue in COPD, as patients feel and complain that chewing, swallowing, and breathing require excessive effort, leading to breathlessness during meals or a sensation of bloating due to swallowed air [ 66 ]. On the other hand, overweight is also a problem in COPD (especially central, visceral obesity) since excess weight can disrupt proper lung expansion during breathing, and obesity itself can increase the body's oxygen demand [ 67 ]. Both overweight and underweight COPD patients often experience breathlessness during eating [ 68 ], which can be alleviated with proper posture and rest before/after meals [ 69 , 70 ].

A nutritional state plays a significant role in the progression of COPD; therefore, dietary intervention must be an essential part of the treatment [ 71 ]. Patients in good nutritional condition are more likely to maintain physical activity, which impacts their quality of life, while poor nutritional status reduces the chances of survival [ 7 , 71 ]. With an appropriate diet and regular exercise, the risk of mortality significantly decreases, and patients' physical fitness and quality of life can substantially improve, influencing the prognosis of the disease [ 7 ]. Chronic obstructive pulmonary disease is characterized by a mixed form of malnutrition, depletion of visceral and muscle proteins, exhaustion of fat stores, impaired immune defense, and ultimately, energy weakness [ 12 ]. Weight loss is primarily a consequence of skeletal muscle atrophy [ 72 ]. In COPD, muscle mass loss (sarcopenia) is very similar to other conditions associated with chronic cachexia, such as heart failure, renal failure, and cancer-related sarcopenia [ 73 ]. In these chronic diseases, physical frailty is associated with decreased survival and deterioration in functional and quality of life outcomes, justifying the timely initiation of nutritional therapy, aligning with the effectiveness of the studies mentioned above, improving patients' quality of life, increasing physical activity, and well-being [ 74 , 75 ]. A common characteristic of these chronic diseases is the elevated blood levels of inflammatory mediators (e.g., TNF-α, IL-6, INF-γ), while the levels of anabolic hormones (e.g., testosterone, insulin-like growth factor) are lower than normal [ 76 , 77 , 78 ]. The exact trigger for muscle wasting is not precisely

known; however, some studies suggest that TNF-α, while activating nuclear factor kappa-B (NF-kB) and inducing nitric oxide synthase (NOS), triggers the breakdown and apoptosis of muscle cells [7, 79].

While COPD is a severe and chronic disease, patients can take various measures to ease their breathing. Although the disease is incurable, certain lifestyle changes such as quitting smoking, increasing physical activity, adopting optimal quality and quantity of nutrition, and dietary supplementation are necessary for its management [80]. The goals of therapy include reducing symptoms, slowing disease progression, improving overall health, increasing physical activity, preventing and managing exacerbations, and ultimately enhancing the quality of life [81]. The diet is described as a modifiable risk factor in the development and progression of chronic diseases [82], and emerging evidence increasingly emphasizes its role in preventing obstructive pulmonary diseases [83, 84].

The high antioxidant content has a positive impact on the quality of life for COPD patients, as the Mediterranean diet, known for being rich in vegetables and fruits—namely antioxidants—and low in saturated fats [86, 87]. Oxidative stress plays a crucial role in the development of age-related chronic diseases, and there is evidence that improper nutrition can elevate oxidative stress levels, systemic inflammation, the risk of chronic diseases, tissue damage, airway inflammation, COPD exacerbations, and abnormal immune responses [88]. Recent epidemiological studies have reported potential beneficial effects of antioxidant-rich foods, particularly fresh fruits and vegetables, on the lung function and symptoms of individuals suffering from chronic respiratory diseases [89, 90, 91]. A randomized controlled trial revealed a significant increase in forced expiratory volume in 1 second ($FEV_1$) over one year among COPD patients following a diet rich in fruits and vegetables compared to controls ($p = 0.03$) [27]. These observations collectively indicate that fruit and vegetable consumption is a crucial determinant in respiratory function and the risk of COPD [89].

Studies have described that antioxidants and flavonoids found in plant-based foods reduce airway inflammation, leading to improvements in forced expiratory volume in 1 second ($FEV_1$) and forced vital capacity (FVC) in patients with chronic respiratory diseases [84, 92, 93]. Increasing fiber intake, due to its anti-inflammatory effects, is also a potential method for managing respiratory symptoms [94]. The Mediterranean diet has long been considered the healthiest diet [95, 96], with its health benefits largely attributed to its fiber content, antioxidants, proteins, and moderate fat intake, primarily monounsaturated fats and omega-3 polyunsaturated fatty acids (PUFA) [95]. Omega-3 PUFAs have gained significant attention for their anti-inflammatory properties and anticoagulant effects, thereby reducing the risk of cardiovascular diseases [93]. They are essential from a nutritional perspective and are primarily obtained from sea products (e.g., fatty fish) [93]. On the other hand, omega-6 fatty acids, including linoleic acid and its long-chain derivative arachidonic acid, which are mainly found in vegetable oils (such as soybean, corn, and sunflower oil), dairy products, and eggs, have been described to have inflammatory effects [97]. It is suggested that the Western diet, with increased consumption of omega-6 fatty acids and decreased consumption of omega-3 fatty acids, may have contributed to the increased prevalence of chronic inflammatory diseases [98, 99]. Some previous studies indicate that increased consumption of fish and plant-based sources of omega-3 PUFAs can reduce the severity of COPD, suggesting that healthy nutrition could be a beneficial intervention for COPD patients [84, 100, 101].

Observational studies have reported independent beneficial effects of whole grain intake on respiratory function [ 83 , 84 , 102 ] and symptoms of chronic respiratory diseases [ 50 ]. Whole grains are rich in phenolic acids, flavonoids, phytic acid, vitamin E, selenium, and essential fatty acids, which collectively contribute to their beneficial effects [ 103 ]. Their high fiber content also endows them with antioxidant and anti-inflammatory properties, with increased fiber intake associated with lower serum levels of CRP, IL-6, and TNF-α, as well as higher levels of adiponectin [ 104 , 105 ]. When comparing various types of fiber (e.g., cereal, fruit, and vegetable fibers), researchers observed the most significant positive correlation with cereal fiber intake, especially among active smokers and those who quit smoking. However, scientific evidence also supports the beneficial effects of increased fruit and vegetable fiber intake [ 84 , 106 ]. Results from the ECLIPSE study conducted on COPD patients showed that increased consumption of "healthy" foods, such as fruits, fish, tea, dairy products, whole grains, etc., was associated with improved respiratory function, better prognosis, quality of life, exercise tolerance, and lower inflammatory parameters (CRP, white blood cells, surfactant protein D, etc.) [ 107 ].

Finally, there is a growing interest in the potential role of caffeine, widely consumed through coffee, in respiratory health. Meta-analyses have shown an association between regular - caffeine-containing - coffee consumption and improved respiratory function, as well as reduced mortality from respiratory diseases, but not specifically from COPD. This can be attributed to the bronchodilator and anti-inflammatory effects of caffeine, as well as the antioxidant properties of its polyphenols. However, smoking is a significant confounding factor in these studies, as it can accelerate caffeine metabolism and clearance and, due to its strong inflammatory effects, may mitigate the beneficial effects of caffeine [ 108 ].