

## Nutritional Status in Patients with Chronic Obstruction Pulmonary Disease (COPD) - Review Article

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### Abstract

This article considers the association of respiratory disease and nutritional status, the determinants of appropriate nutritional support in respiratory disease, the use of enteral nutritional support opposite of malnutrition, and disorders due to malnutrition and finally nutritional support in them. Nutrition is an important aspect of patient care in any patient with respiratory disease special in COPD. Malnutrition adversely effects lung function by diminishing respiratory muscle strength, altering Ventilatory capacity, and impairing immune function. Repletion of altered nutritional status or refeeding results in improvement of altered function and may be important in improving outcome. Unfortunately, as with any therapy, complications of nutritional support exist. Those complications presenting special problems to the patient with respiratory disease are nutritionally related hypercapnia and aspiration of enteral feedings. Although patients with a variety of respiratory diagnoses are appropriate targets for this discussion, the article will deal largely with patients with COPD, as this is the respiratory disease most commonly studied and COPD patients that need to nutrition support aged 40 - 75 years, consecutively admitted and hospitalized and mean body weight for males was  $50.03 \pm 9.23$  kg and females were  $47.66 \pm 4.04$  kg. Considering the usual weight of them, it was observed that the present body weights of patients were significantly decreased during of time of they have malnutrition and without of nutrition support. General principles involved in the nutritional care of the COPD patient can be applied to patients with other respiratory diagnoses. Currently, there is confusion about the value of using nutritional support to treat malnutrition and improve functional outcomes in COPD. A person's nutritional status can influence the degree of severity of COPD, and COPD can create circumstances that make consuming an adequate diet difficult. Food is the fuel that provides your body with the energy it needs to perform all activities. People with COPD use more energy breathing and therefore need more food (sometimes up to 10 times the calories). Unfortunately, eating more food makes you have more trouble breathing because of the amount of food in your stomach. Losing too much weight will make you tired and weak and will make you more likely to get an infection. Chronic obstructive pulmonary disease is characterized by progressive and partially reversible airway obstruction. The innumerable complications that occur during the progression of the disease can affect the nutritional state of patients suffering from this illness. Malnutrition is associated with a poor prognosis for patients with COPD, since it predisposes such patients to infections, as well as reducing respiratory muscle force, exercise tolerance and quality of life. Despite the fact that such malnutrition is extremely common in COPD patients, it should be recognized as an independent risk factor, since it can be modified through appropriate and efficacious diet therapy and monitoring. For patients with COPD, nutrition therapy is initiated after the evaluation of the nutritional state of the patient, which identifies nutritional risk, thereby allowing the proper level of treatment to be established.

**Keywords:** Patients with COPD, Nutritional status, Malnutrition, Weight loss.

## Introduction

Reduced respiratory function and a decline in fat-free mass result in reduced exercise tolerance and peripheral muscle weakness, both disabling features of COPD, which are associated with a poorer quality of life (QoL). Fat-free mass depletion (even if body mass index (BMI) is within the ideal range) has recently been found to be a significant independent predictor of disability even after adjustment for disease severity. Disease-related malnutrition is a common problem in individuals with COPD, with between 60% of inpatients and 40% of outpatients said to be at risk. Malnourished COPD patients demonstrate greater gas trapping, lower diffusing capacity and a reduced exercise performance when compared with heavier non-malnourished patients with a similar severity of disease. However, the exact causal links between malnutrition and COPD are difficult to establish. Malnutrition may be the consequence of greater disease severity. Alternatively, malnutrition may be responsible for the wasting of the muscles involved in breathing, exacerbating the progressive nature of COPD. Similarly, in chronic anorexia nervosa, the loss of body weight includes substantial loss of lung tissue, which develops emphysema to us like changes. In addition to the uncertainty about the causal links between malnutrition and COPD, there are controversies about how effective nutritional support is in this patient group. Previous reviews and meta-analyses suggested that malnutrition fails to respond to nutritional treatment in COPD finding no significant improvements in anthropometric or functional measures. These reviews have been challenged by several randomized, controlled trials (RCT), and a recently published meta-analysis concluded that nutritional support was able to significantly increase nutritional intake (energy and protein), which was associated with a significant improvement in a variety of anthropometric measures. The contrast in conclusions between the reviews has been largely attributed to methodological differences in data analysis discussed at length in the paper. In essence, the previous Cochrane Collaboration review carried out cross-sectional analysis between intervention and control groups but failed to account for baseline variability. The other review accounted for pre- and post-intervention variability finding a number of significant within-group improvements to be masked by cross-sectional analysis. Nevertheless, confusion remains over whether the recent positive findings translate beyond nutritional intake and body weight, and into functional improvements [1]. A diet deficient in calories, protein and vitamins and minerals has a negative effect on immune function in COPD. The body's cells that fight infection are made of proteins. Poor diet makes it difficult for the body to build new immune factors to fight infection and to repair damaged tissues. Decreased appetite and increased caloric needs may then start another debilitating cycle. For this reason and the ones above, the COPD patient must achieve a balance of good nutrition and exercise to stay as healthy as possible. Metabolism is the name of the process that converts the food you eat to the energy needed by every cell in your body. During metabolism, food and oxygen are changed to carbon dioxide (CO<sub>2</sub>), energy and water. Some people with COPD have too much carbon dioxide in their blood and it is beneficial to try to reduce the amount of extra CO<sub>2</sub>. Good news, foods that are higher in fats will give you the calories and energy you need without producing that much CO<sub>2</sub>. Carbohydrates break down and produce more CO<sub>2</sub> therefore should be eaten in very small amounts [2].

COPD is a state of systemic inflammation that causes changes in body composition, metabolism, and immune status. These systemic effects contribute to weight loss and skeletal muscle wasting, limiting the exercise capacity of these patients, and worsening the prognosis, independent of their pulmonary function. Significant loss in fat-free mass (FFM) is related to impaired skeletal muscle strength and exercise capacity. Weight loss also reduces diaphragmatic muscle mass and depresses diaphragm contractility. Various hypotheses proposed for the pathophysiologic mechanisms for weight loss in COPD include increased resting energy expenditure (REE), inadequate dietary intake, systemic inflammation, tissue hypoxia and medications. The factors that are implicated in the increase in REE include systemic inflammation causing hyper metabolism and increased respiratory muscle work due to increased oxygen consumption of the respiratory muscles secondary to an increased resistive load and an impaired respiratory muscle insufficiency. More specifically, muscle wasting is a consequence of an imbalance between protein synthesis and protein breakdown. Individuals with low weight have more gas trapping, lower diffusing capacity, and lower exercise capacity than those with similar pulmonary mechanics but with normal weight. Several studies have shown an association between malnutrition and impaired pulmonary status among patients with COPD. However,

there is no clear relationship between measures of nutritional status and airflow obstruction. Malnourished subjects have worse scores on a respiratory disease-specific quality of life questionnaire than do adequately nourished individuals. Malnutrition varies between 20% and 70% among different patient with COPD [3].

### **Nutritional support in COPD**

Researchers and physicians mentioned that the optimum mode of nutrition in any patient is oral, spontaneous intake of an appropriate balanced diet. Unfortunately, patients with respiratory disease (COPD) may require supplementation or even complete nutritional support, depending on the severity and intensity of illness. However, the principles of nutritional support are independent of the type of respiratory disease, the mode of nutritional administration, or the severity of respiratory illness. Whether nutritional support requires either supplementation or total support, the following discussion will focus on enteral nutrition, as the enteral route is preferred whenever nutritional support is indicated [4].

### **Malnutrition in COPD**

Malnutrition is common finding among patients with COPD, and is a form of adaptation to chronic malnutrition. The prevalence of malnutrition among outpatients ranges from 20% to 25%, and it varies from 34% to 50% in patients hospitalized with COPD. It results in decreased respiratory performance due to the depletion of muscle proteins. In addition, it increases susceptibility to pulmonary infections. Malnutrition in COPD does not depend on a single mechanism. Various studies suggest that its etiology is multifactorial, and that the two principal mechanisms involved in its genesis are inadequate ingestion of food and increased energy expenditure. Various factors, such as difficulties in mastication and swallowing resulting from dyspnea, cough, secretion, and fatigue, can lead to inadequate ingestion of food, and consequently to weight loss, in patients with COPD. A peptic ulcer is a common finding in patients with COPD. Corticosteroids also have a quite significant negative impact on the nutritional state of these patients, due to appetite loss, bone demineralization, and weakening of the muscle mass. Increased energy expenditure in patients with COPD can be attributed to hyper metabolism subsequent to an increase in respiratory muscle work, which results in greater demand for oxygen. These muscles are subjected to increased demand and present decreased mechanical efficiency. It has been shown that, due to the increased respiratory work and increased inflammatory mediators, in addition to the influence of medication, the basal metabolic rate is 15% to 17% higher in patients with COPD. The increased basal metabolic rate occurs more frequently in patients with severe COPD and can result in weight loss. Inter current infections and surgical procedures can lead to anorexia and to greater catabolism, resulting in the loss of muscle mass. Leptin is a protein synthesized by the adipose tissue that plays an important role in the energy metabolism. This hormone is a signal for cerebral and peripheral tissue alterations, also regulating caloric intake, basal energy expenditure, and body weight. Recent studies suggest that the increased production of inflammatory mediators can alter the leptin metabolism in patients with COPD, thereby contributing to weight loss [5,6].

### **Nutrition Therapy in COPD**

The treatment for COPD includes a series of procedures, from prophylactic measures to those specifically related to the correction of the alterations caused by the disease. A comprehensive treatment regimen can relieve the symptoms, reduce the number of hospitalizations, prevent premature death, and grant patients a more active and satisfactory life. Nutrition therapy is quite important in COPD due to its great impact on the morbidity and mortality caused by the disease. The data in the literature show that malnutrition is associated with a high rate of mortality in COPD patients, from 33% at the onset of the weight loss process to as high as 51% after five years. A formal rehabilitation program for patients with COPD, using a team approach, presents a highly efficacious result [7,8].

### **Evaluation of the nutritional state in COPD**

The objective of the evaluation of the nutritional state of patients with COPD is to identify the organic and metabolic alterations that depend on nutrition or that can be mitigated by adequate dietary treatment. Various methods can be used in the evaluation of the nutritional state; such methods include subjective global nutritional evaluation, evaluation of dietary intake, anthropometry, and

determination of body composition in clinical researches. An isolated parameter does not characterize the general nutritional condition of an individual, and it is therefore necessary to use a combination of various nutritional state indicators to increase the diagnostic precision [5,9].

### Anthropometry

Anthropometry is widely used in the evaluation of the nutritional state due to its easy application, low cost, and noninvasive nature. The anthropometric measures most often used are weight, height, skinfold thickness, and circumferences. Due to its practicality, the BMI [body weight (kg)/height (m)<sup>2</sup>] has been used as a good indicator of the nutritional state. However, this index does not portray individual differences in body composition. According to the literature, the degree of severity of pulmonary diseases is associated with BMI, a low BMI being related to high mortality risk in patients with severe COPD. In a study analyzing the factors that influence the quality of life of patients with COPD, it was observed that BMI, independently, has a significant influence on the quality of life of these patients. The Nutrition Screening Initiative, the American Academy of Family Physicians, and the American Dietetic Association have suggested the following BMI values as cut-off points for patients with COPD: 22-27 kg/m<sup>2</sup> for normal weight; < 22 kg/m<sup>2</sup> for malnutrition; and > 27 kg/m<sup>2</sup> for obesity. In 2004, an index comprising four fundamental aspects of the disease was created. This index was designated the Body mass index, airway Obstruction, Dyspnea, and Exercise capacity (BODE) index. The BODE index is a COPD predictor of mortality, since it combines the various factors that can be indicators of mortality in these patients. The BMI cutoff point used in the BODE index is kg/m<sup>2</sup>, since values lower than this have been associated with an increased risk of death. Determining body fat reserves in patients with COPD is extremely important, since, without these reserves, the organism begins to mobilize its own protein reserve as an energy source. Measurement of skinfold thickness constitutes a quite convenient method of estimating the body fat reserve. In patients suffering from chronic diseases, measurement of skinfold thickness can be useful in the evaluation of the long-term changes that occur in the subcutaneous adipose tissue reserves. Through the summation of the triceps, biceps, subscapular and supra-iliac skinfold thicknesses, it is possible to calculate the body composition of an individual. Half of the body fat is located in the subcutaneous tissue and, with advancing age, the internal fat deposition also increases. Therefore, measurement of skinfold thickness is not ideal for the evaluation of elderly patients. However, the measurement of the circumference of the arm satisfactorily reflects the body protein reserve. This information deserves special attention during the evaluation of the nutritional state of elderly patients with COPD. Muscle mass depletion is the principal factor responsible for the negative effects attributed to malnutrition. The muscle protein reserves are mobilized to meet the demand of the protein synthesis in the patients with chronic diseases, and can result in muscle depletion, which represents a serious problem for patients with COPD. The arm circumference is an anthropometric parameter of nutritional evaluation and is quite often used to estimate the total skeletal muscle protein. Through measurement of arm circumference and triceps skinfold thickness, it is possible to calculate the muscle circumference and the arm muscle area, low values of which are good indicators of severe depletion of muscle mass and fat reserve [5,12].

### Bio Impedanciometry

The bioelectrical impedance (bio-impedance) technique is employed to measure the conductive properties of an individual and thereby define the body composition and type, as well as to determine the volume and distribution of fluids and tissues. The estimation of body composition through the use of bio-impedance has frequently been used, because it is easily applied and is a noninvasive method. Patients with emphysema and COPD typically present lower percentages of body fat and lower BMIs than do patients with chronic bronchitis and normal individuals. Bio-impedance is a highly precise method of evaluating of the body composition of patients with chronic diseases. However, it presents low sensitivity in predicting alterations in body composition over a short period of time. The literature also shows that, in the evaluation of the body composition of elderly patients with COPD, bio-impedance is preferable to the measurement of skinfold thickness [12].

**Nutritional practices in COPD**

Nutrition that is appropriate in quantitative and qualitative terms is of fundamental importance in the treatment of COPD. The principal objectives of nutrition therapy in COPD are summarized in table [1]. According to the results of the evaluation of the nutritional state, patients with COPD can be divided into two groups. The first group comprises the patients who presented high risk of nutritional complications due to the exacerbation of the disease. In this case, the objective of the dietary treatment is to prevent protein-calorie malnutrition, as well as its consequences, by providing adequate nutrition. The second group comprises those patients who presented malnutrition, with or without respiratory insufficiency. For this group, the objective of the dietary treatment is to reverse the malnutrition profile through nutrition in order to ensure the reposition of all the deficient macronutrients and micronutrients. The reversal of malnutrition in patients with COPD results in improvement of the immune response of the neutrophils and of the complement, thereby strengthening the defense of the organism against infections. Improvement in respiratory muscle function, reversal of the alterations of the Ventilatory response, and normalization of the surface forces have also been observed subsequent to the normalization of the rate of phosphatide l choline synthesis in the pulmonary tissue and in the Broncho alveolar lavage fluid. Although malnutrition is extremely common in patients with COPD, being an indicator of worse prognosis, it is important to recognize it as an independent risk factor, since it can be potentially modified through appropriate and efficacious dietary treatment [13].

S. No	Objectives of Nutrition Therapy in COPD
1	Providing nutrition that promotes maintenance of respiratory muscle force, mass, and function in order to optimize the global performance status of the patient and satisfy the demands of daily activities.
2	Maintaining an adequate reserve of lean body mass and adipose tissue, since patients with COPD present alterations in body composition, manifested by weight loss, and, principally, muscle mass loss.
3	Correcting the water imbalance that is common in patients with COPD.
4	Controlling the interaction between drugs and nutrients that negatively interfere both in the consumption of food and in the absorption of nutrients.
5	Promoting an improvement in the quality of life of the patient.

*Table 1: Objectives of nutrition therapy in COPD in the long time processing.*

**Dietary adaptations in COPD**

The consistency of the diet for patients with COPD should be adapted to the physiological conditions of each patient. It should be specifically noted whether the patient presents dental problems, which can affect proper chewing of food, or dyspnea, which impairs the ability to eat. In these cases, it is necessary to implement a mild or soft-food diet. The diet must be well distributed at intervals, in order to offer the patient between five and six meals, of lesser volume, per day. In patients with COPD, large meals can cause fatigue and anorexia, thereby limiting the consumption of food. In the vast majority of cases, individuals affected by COPD are elderly. One of the physiological modifications that occur with aging is the decrease of the thickness of the tissue of the mouth and tongue mucosa, whose appearance becomes smoother and thinner. Therefore, there is an increase in the thermal sensitivity in the oral mucosa, which makes these patients more intolerant to foods of extreme temperatures. It is recommended that these patients be served mild temperature food, in order to avoid damages to the oral mucosa. Xerostomia is a quite common symptom in the elderly, and can also occur as a consequence of the use of some medications (antidepressants, antihypertensive, and bronchodilators), resulting in difficulty in chewing, swallowing, and digesting food. Therefore, its presence should also be considered when choosing a more appropriate consistency of food [5,13].

### Type of food in COPD

When living with COPD, nutrition should take high priority. COPD patients that need to nutrition support aged 40 - 75 years, consecutively admitted and hospitalized and mean body weight for males was  $50.03 \pm 9.23$  kg and females were  $47.66 \pm 4.04$  kg. People with COPD have higher calorie requirements due to the effort it takes to breathe calorie usage of the muscles involved every time you take a breath could be 10 times greater for someone with the condition. You might not think calorie requirements merit concern if you're overweight, but being overweight doesn't mean you're adequately nourished.

### Proteins

Protein is important because it plays an essential role in protecting the body. It produces antibodies to fight infection. Loss of protein and the general difficulty to maintain a good nutritional status may severely reduce the lungs' ability to defend against infection, in COPD patients. The primary sources of protein are meat, fish, eggs, poultry, legumes and dairy products. If COPD patients are not getting enough protein in diet use the following guidelines. These guidelines are also helpful if they have an infection and need extra protein:

- a. Add skim milk powder to hot milk, cereal, eggs, soups, casseroles, gravies and ground meat dishes. This will add extra protein and calcium to diet.
- b. Add chopped high protein poultry, meats, cheese or legumes to soups and casseroles and vegetables. Nuts also can be added.
- c. Blend finely chopped hard-boiled egg or egg substitute into a sauce, gravy or soup.
- d. Include high protein snacks such as pasteurized eggnog, instant breakfast and puddings in diet.

Commercially prepared supplements may be needed in some cases. Have peanut butter, bean dips, nuts, cottage cheese or other cheese with snacks to add additional protein and calories. Try using double strength milk (add 1 cup powdered milk to 1 quart whole milk).

### Fluids

Drinking enough fluids is essential for the thinning and clearance of pulmonary secretions in COPD patients. Also, supplemental oxygen therapy may dry your mucus membranes and cause irritation. Fluids keep you hydrated. The recommended fluid intake for COPD patients is 8 to 12 cups of caffeine-free liquids per day. Water is essential to the body. It helps prevent constipation. Drinking plain water may be your best source of fluid. Fruit juices, decaffeinated coffee and tea are also good sources. Milk is a good source of fluid. It has the added benefit of providing many healthy nutrients. Ask primary care provider about the amount of fluid COPD patients should drink each day. Researchers found that among nearly 2,200 adults with COPD, those who ate fish, grapefruit, bananas and cheese tended to have better lung function and fewer symptoms than their counterparts who did not eat those foods. For the current study, Hanson's team (2014) used data from a larger project that followed COPD patients over three years. At eight different time points, the participants were asked whether they had eaten grapefruit, bananas, fish or cheese over the past 24 hours. In general, people who had eaten any of those foods showed better lung function on standard tests, had a quicker walking pace, and tended to have lower levels of certain inflammatory indicators in the blood. There's no good reason to suspect that eating a lot of cheese, for example, would boost lung function. But, Hanson said, cheese might be an indicator of people's intake of vitamin D, which, some evidence suggests, might help COPD patients breathe a bit easier.

### Discussion

The prevalence of COPD has grown rapidly over the last few decades, with considerable economic and social impact. Various studies have demonstrated the importance of nutrition therapy to improving the clinical profiles of these patients. The treatment for malnutrition and other nutritional complications associated with COPD is fundamental to the evolution of the clinical profile, as well as to the improvement of the quality of life of the patient. Individualized nutrition therapy is quite important and should be instituted as early as possible in order to improve patient nutritional state, immune function, respiratory muscle function, and exercise tolerance [5]. This review found that nutritional support in COPD produces significant improvements in several functional outcomes including

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respiratory and limb muscle strength. These findings demonstrate the positive effects of nutritional support on respiratory muscle tests and other functional outcomes, building on the conclusions of a recent review that nutritional support significantly improves energy and protein intakes with resulting increase in body weight. However, it did consider methodological issues, including those involved in an earlier Cochrane review. The findings of the present review also strengthen the argument that a causal pathway exists linking increased nutritional intake provided primarily to increased body weight and function. The current findings are in contrast with the previous Cochrane review including the same trials that reported no effect of nutritional support in COPD probably because it considered only cross-sectional differences between groups at the end of the intervention period and not with in group changes induced by the interventions. However, an updated Cochrane review, which appeared very recently following submission of the present review for peer review, changed its conclusions. A comparison of this review with the updated Cochrane review is provided after the main findings of the present review are discussed. The current review with a series of meta-analyses found that for each of the tests used to document improved respiratory muscle function (PI max and PE max) and non-respiratory (handgrip/quadriceps) muscle strength, there was a highly significant increase in body weight of more than 2 kg (2.1-3.1 kg) in favour of the nutrition intervention group. Schols *et. al.* [14] found that both an improved inspiratory mouth pressure (PI max) and a weight gain of > 2 kg were associated with significantly improved survival in keeping with a previous review reporting that significant functional improvements were seen in malnourished patients when weight gain was > 2 kg. The current review confirms that weight gain of this magnitude is associated with functional improvements in this patient group. From the above observations, we may conclude that patients with COPD are generally malnourished and the prevalence is more in a developing country like India. Nutritional interventions in the form of dietary supplement have shown improvement in anthropometry, exercise capacity but did not show any significant improvement in pulmonary function. However, the variable outcome may be due to a small study population, shorter duration, different modes of intervention, and variable COPD severity [3,14].

Physicians should evaluate nutritional status and intake in all patients with respiratory disease. When spontaneous oral intake is judged inadequate, consideration should be given to supplementing oral intake with enteral nutritional formulations or, in cases of critical illness, providing complete nutritional support with enteral feeding. Estimation or calculation of total energy needs is of vital importance in the patient with respiratory disease to prevent under- or overfeeding. Reduction of carbohydrate calories, especially in supplemental nutritional formulations, appears to be of little value and not necessary when appropriate nutritional support is provided [4,16].

### Conclusion

This review described the types and magnitude of functional benefits that are likely to arise through nutritional support. It suggests that at least some of the adverse functional consequences of severe COPD are reversible by nutritional support. Because malnutrition adversely affects the COPD patient by impairing respiratory function, increasing symptoms and worsening outcome and we need to methodological treatment such as nutrition therapy and dietary adaptations and nutrition practice could be control or decrease side effects of malnutrition in these patients. The review also suggests that while several of the studies were judged to be of high quality, many were of lower quality, and therefore, the evidence base for the role of nutritional support in COPD needs to be strengthened with sufficiently powered randomized, controlled trials (RCT) in COPD patients. Considering the usual weight of COPD, it was observed that the present body weights of patients were significantly decreased during of time of they have malnutrition and without of nutrition support.

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