

**Pulmonary rehabilitation and nutritional support in COPD patients with altered body composition and poor exercise capacity**

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**AIMS**

- To describe the factors limiting exercise tolerance in severe COPD patients.
- To emphasize the value of high-intensity interval exercise training in COPD patients with peripheral muscle weakness.
- To make recommendations for anabolic hormone and specific nutritional supplementation for COPD patients with altered body composition.

**SUMMARY**

Physical exercise training is the cornerstone of any cardiopulmonary rehabilitation programme. Training sessions may combine aerobic and resistance muscle re-conditioning sessions. Aerobic exercise training can include either continuous or interval exercise modes. In addition, resistance training consists of arm, leg and trunk exercises [1, 2, 3].

In view of the fact that the intensity of the training stimulus is a critical determinant of the magnitude of physiological adaptations that occur in response to regular exercise, high intensity continuous exercise training may not be feasible for those COPD patients who are unable to sustain high intensities for long periods of time due to symptom limitations [4]. Accordingly, when exercising continuously without any rest periods, severe COPD patients can tolerate relatively moderate work rates (50–80% of their maximum exercise capacity) for approximately 5-15 min, at the end of which they are symptom limited [4]. At intensities of 75-85% of peak exercise capacity, COPD patients can sustain only 4-5 min of exercise [5] and only up to approximately 13-15 min for lower intensities (50-60% of peak exercise capacity) [5]. As such, implementing continuous exercise training for patients with severe COPD may prove ineffective, as they will have to interrupt exercise in order to rest for several minutes before they start exercising again. In contrast, interval training can enable patients to complete short periods of high-intensity exercise that would not be possible with a continuous exercise mode.

Indeed, when COPD patients exercise for short period of time (*e.g.* 30 s) alternated with equal periods of rest intervals, patients are able to complete the total amount of work with lower symptoms of dyspnoea and leg discomfort compared with moderate constant-load exercise training [5]. Delayed occurrence of lactic acidosis observed during interval exercise appears to be beneficial by reducing respiratory drive, thereby lowering dyspnoea sensations and the occurrence of peripheral muscle fatigue [6]. Thus, interval exercise is more affordable by patients with advanced disease.
A recent study demonstrated that interval exercise training allows severe COPD patients to exercise at a sufficiently high intensity to obtain true physiological training effects manifested by improvements in muscle fibre size, typology and capillarization [7].

Furthermore, patients with severe COPD are often exposed to the risk of profound peripheral muscle de-conditioning as a result of disease severity and progression. Intense sensations of leg discomfort often deter COPD patients from participating in daily activities that require body mobility and strength. Since skeletal muscle weakness has a negative impact on exercise tolerance in the majority of patients with severe COPD, an intervention of resistance exercise during pulmonary rehabilitation is deemed essential [8]. Accordingly, rehabilitation experts often prescribe resistance muscle training programmes, as clinical outcomes are definitely promising for the severe COPD patient [9].

Accordingly, short-term progressive resistance muscle training can be beneficial for severe COPD patients in terms of enhancing muscle strength and increasing the performance of some daily activities. Progressive resistance exercise can increase arm and leg muscle strength and improve the performance of tasks, such as stair climbing and rising from sitting [10]. However, the effects of progressive resistance exercise on measures of body composition, psychological function and societal participation still remain inconclusive.

Exercise training should be tailored to address the individual patient’s limiting factors (central cardiorespiratory and/or peripheral muscle) to exercise. In patients with intense dyspnoea symptoms, interval exercise is more appropriate than continuous exercise [5]. Resistance exercise should be complementary to interval exercise so as to improve the strength of both the upper and the lower body muscles. In patients with profound muscle weakness, interval and resistance exercise should constitute a training priority.

A multidisciplinary therapeutic approach is absolutely required in severe patients with COPD and nutritional abnormalities. Certainly, several factors need to be targeted, such as smoking cessation, improvements in daily physical activity levels and exercise performance, a reduction in the number of acute exacerbations, and avoidance of the use of systemic corticosteroids as much as possible. In addition, anabolic hormones and specific nutritional supplements should also be recommended in those patients.

More specifically, nutritional intervention in patients with COPD should aim to provide a sufficient amount of energy, proteins, and amino acids to promote protein synthesis, thereby counterbalancing the increased catabolism and atrophy observed in their muscles [11]. Supplements containing high levels of branched-chain amino acids will be very beneficial in COPD patients with severe malnutrition and muscle mass loss [12, 13]. The advantages of certain compounds, for example, whey proteins, rely on several other features such as their high content in leucine to initiate protein synthesis, their rapid rate of absorbance in the gut, and their amino acid composition to become a substrate for de novo protein synthesis, which are all key factors that significantly influence the outcome of nutritional support in patients [14].

Testosterone is an anabolic hormone, which increases protein synthesis and reduces proteolysis, while it also enhances lipolysis. Megestrol, which is a synthetic compound derived from progesterone, has been shown to induce orexigenic effects and improvements in body weight in patients with COPD and low body weight, while increasing fat tissue compartment, with no functional improvement [15]. Growth hormone via IGF-1 activation promotes protein synthesis and decreases protein catabolism, together with an increase in calcium resorption and the immune response in patients [12, 16]. GH exerts beneficial effects on total body and muscle weights and muscle strength of specific muscle groups [12, 16]. Another group of drugs with potential beneficial effects on muscle mass are the segretagogues of GH that induce its release. The effects of ghrelin are identical to those exerted by GH, such as induction of protein synthesis, prevention of protein oxidation and degradation, and lipolysis [12, 17].
Increasing the dietary fiber content may also represent another possible intervention in patients with chronic respiratory diseases and nutritional abnormalities. In this respect, gut immunity and systemic inflammation levels are reduced probably as a result of alterations in the gut microbiome induced by dietary fiber intake [17, 18].

As established by international recommendations, vitamin D supplementation exerts beneficial effects on the bones and muscles, while preventing falls in elderly subjects and patients at high risk of vitamin D deficiency such as those with chronic lung diseases [19].

REFERENCES


