

Effects of Whole-Body Exercise Training on Body Composition and Functional Capacity in Normal-Weight Patients With COPD*

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Background: Skeletal muscle wasting is related to muscle dysfunction, exercise intolerance, and increased mortality risk in patients with COPD.

Study objectives: The aims of this study were to investigate the effects of whole-body exercise training on body composition in normal-weight patients with COPD, and to study the relationship between changes in body composition and functional capacity.

Setting and participants: Fifty patients with COPD (FEV₁, 39% of predicted [SD, 16]) admitted to the pulmonary rehabilitation center at Hornerheide, and 36 healthy age-matched control subjects (for baseline comparison) were included.

Interventions: Patients participated in a standardized inpatient exercise training program consisting of daily submaximal cycle ergometry, treadmill walking, weight training, and gymnastics during 8 weeks.

Measurements: Fat-free mass (FFM) was measured by bioelectrical impedance analysis. None of the patients met the criteria for nutritional supplementation (body mass index < 21, or FFM index < 15 kg/m² in women and < 16 kg/m² in men). Exercise capacity was measured using incremental cycle ergometry. Isokinetic quadriceps strength was measured with a Biodex dynamometer (Biodex Medical Corporation; Shirley, NY).

Results: At baseline, patients were characterized by a significantly lower FFM than the control subjects. Age and FFM were independent predictors of skeletal muscle function and exercise capacity in patients. After rehabilitation, weight (72.4 ± 9.8 to 73.0 ± 9.4 kg, $p < 0.05$) significantly increased, as a result of increased FFM (52.4 ± 7.3 to 53.4 ± 7.7 kg, $p < 0.05$), while fat mass (20.0 ± 6.1 to 19.6 ± 5.7 kg) tended to decrease. Peak work rate (63 ± 29 to 84 ± 42 W, $p < 0.001$), maximal oxygen consumption ($\dot{V}O_{2\max}$) [1,028 ± 307 to 1,229 ± 421 mL/min, $p < 0.001$], and isokinetic quadriceps strength (82.5 ± 36.4 to 90.3 ± 34.9 Newton-meters, $p < 0.05$) all improved. Changes in FFM were proportionally smaller than functional improvements, and were related to changes in $\dot{V}O_{2\max}$ ($r = 0.361$, $p < 0.05$), but not to other changes in functional capacity.

Conclusions: Intensive exercise training *per se* is able to induce an anabolic response in normal-weight patients with COPD classified into Global Initiative for Chronic Obstructive Lung Disease stages III-IV. Improvements in exercise performance and muscle function are proportionally larger than increases in FFM.

Key words: aging; anabolic stimulation; body composition; COPD; exercise capacity; exercise training; fat-free mass; muscle strength

Abbreviations: **BMI** body mass index; **Dlco** diffusing capacity of the lung for carbon monoxide; **FFM** fat-free mass; **NS** not significant; **V_{o2max}** maximal oxygen consumption; **Wmax** maximal work rate

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