Exercise Program Improves Insulin Resistance and Functional Limitation in Sedentary Elderly Patients with Obesity

Davidson LE, Hudson R, Kilpatrick K, et al. Effects of exercise modality on insulin resistance and functional limitation in older adults: a randomized controlled trial. Arch Intern Med 2009;169:122–31.

Study Overview

Objective. To determine whether resistance exercise, aerobic exercise, or combined resistance and aerobic exercise regimens produce the greatest improvements in insulin resistance and functional limitation among obese adults.

Design. Randomized controlled trial conducted at a single Canadian academic medical center.

Setting and participants. 136 sedentary, abdominally obese men and women aged 60 to 80 years were recruited via public advertisement between 2002 and 2006. Potential participants were excluded if they reported history of heart disease, stroke, diabetes mellitus, or any medical condition that would preclude participation in study exercise; were already undergoing or planning to start a weight loss diet; were already participating in ≥ 2 exercise sessions per week; or were taking glucose-lowering medication.

Intervention. Participants were randomized to 4 study arms, each lasting 6 months: resistance exercise (three 20-min sessions/wk), aerobic exercise (five 30-min sessions/wk), combined resistance and aerobic exercise (three 50-min sessions/wk), and nonexercise control. All exercise sessions were supervised, with automated heart rate monitoring during aerobic exercise and assurance of good form during resistance exercise. Participants were followed for 6 months and were instructed to maintain a constant caloric intake throughout the study period.

Main outcome measures. Changes from baseline to 6 months in insulin resistance, measured by 3-hour hyperinsulinemic-euglycemic clamp, and in 4 functional limitation measures: (1) maximal number of chair stands in 30 seconds; (2) maximal number of steps in place in 2 minutes; (3) time required to rise from a chair, walk 2.4 meters, return to the chair, and sit down; and (4) maximal number of times a hand weight could be curled through a full range in 30 seconds. Change in functional limitation was assessed using a single composite score of the 4 functional measures. All outcomes were assessed by technologists who were blinded to treatment group.

Main results. At 6 months, insulin resistance improved in the aerobic exercise and combined exercise groups, but no change was seen in the resistance exercise group. Improvement in mean insulin resistance was greatest among participants receiving combined exercise (9.2 mg/mL/μIU per kg skeletal muscle per min × 100; $P < 0.05$ vs. resistance or control), followed by aerobic exercise (6.5 mg/mL/μIU per kg skeletal muscle per min × 100; $P < 0.05$ vs. resistance or control), resistance exercise (1.8 mg/mL/μIU per kg skeletal muscle per min × 100; $P > 0.05$ vs. control), and nonexercise control (0.3 mg/mL/μIU per kg skeletal muscle per min × 100). Improvement in functional ability was greatest among participants in the combined exercise group (composite z score, 0.52; $P < 0.05$ when compared with aerobic or control), followed by resistance exercise, aerobic exercise, and nonexercise control (composite z scores, 0.17, –0.01, and –1.01, respectively; $P < 0.05$ for resistance and aerobic

exercise only vs. control). Analyzed separately, each of the 4 functional measures exhibited substantively similar improvement patterns across treatment groups.

Conclusion. Combined resistance and aerobic exercise regimens may produce greater improvements in insulin resistance and functional limitation among sedentary obese older adults than either exercise modality alone. However, the case for widespread adoption of supervised combined exercise regimens would be strengthened by a cost-benefit analysis that incorporates outcomes such as mortality and morbidity.

Commentary

Insulin resistance and functional disability are increasing problems among the obese elderly, and recent guidelines of the American Heart Association encourage both resistance and aerobic exercise to maintain overall health among older adults [1–3]. Insulin resistance, which has been associated with development of diabetes, stroke, and coronary heart disease, presents an attractive target for disease prevention efforts [4–6]. Functional disability (as measured by simple tests that can be performed in a doctor's office) has been associated with decreased ability to perform activities crucial to independent living, such as walking, climbing stairs, and other activities of daily living.

Prior studies of combined resistance and aerobic exercise have demonstrated improved glucose control among patients with diabetes compared with either modality alone [7]. Similarly, a small trial of combined exercise demonstrated enhanced improvement in strength and agility among healthy older adults [8]. However, the differential effects of combined, resistance, and aerobic exercise on insulin resistance and functional limitation have not been previously studied in a randomized trial.

The current investigation by Davidson and colleagues compares the effects of resistance, aerobic, and combined exercise on insulin resistance and functional limitation among older, sedentary and abdominally obese adults. After 6 months, combined exercise and aerobic exercise produced greater improvements in insulin resistance than resistance exercise alone, and combined exercise produced a greater improvement in functional ability than either exercise modality alone. Although resistance exercise did not improve insulin resistance compared with the nonexercise control group, all types of exercise resulted in functional limitation improvement compared with the control group.

This study has some important limitations. First, exercise times differed between regimens: 60 minutes per week for the resistance exercise regimen versus 150 minutes per week for both the aerobic and combined exercise regimens. The dissimilarity in total exercise time may confound the relationship between exercise modality and study outcomes, especially for insulin resistance, where total exercise time could be construed as the more important predictor of improvement. Second, because the 136 study participants were recruited over 4 years, there is the possibility that intervention and patient characteristics may have varied over the study period. Finally, study participants were not recruited randomly from the eligible population. Of 1876 patients initially screened for inclusion, only 272 were eligible, and of these, only 136 (50%) participated in the study (with the most common reason for nonparticipation was "unable to commit to a 6-month program"). This nonrandom study participation limits the generalizability of findings to patients who may be less eager to exercise.

Applications for Clinical Practice

This study adds to mounting literature demonstrating the beneficial effects of exercise on a broad array of health outcomes and suggests that combined resistance and aerobic exercise may be superior to either modality alone. To encourage broader use of supervised exercise regimens, comparative effectiveness studies that compare exercise to drug- and procedure-based interventions should be considered.

—Review by Mark W. Friedberg, MD, MPP

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