Aerobic plus resistance training was more effective than either alone for reducing HbA_{1c} levels in type 2 diabetes

Sigal RJ, Kenny GP, Boule NG, et al. **Effects of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: a randomized trial.** Ann Intern Med. 2007;147:357-69.

Clinical impact ratings: GIM/FP/GP ★★★★★★☆ Endocrinology ★★★★★☆☆ Phys Med & Rehab ★★★★★☆☆

QUESTION

In persons with type 2 diabetes, how do aerobic, resistance, and combined training compare for reducing hemoglobin (Hb) A_{1c} levels?

METHODS

Design: Randomized controlled trial (Diabetes Aerobic and Resistance Exercise [DARE} trial.

Allocation: Concealed.*

Blinding: Blinded ({data collectors}† and outcome assessors).*

Follow-up period: 6 months.

Setting: 8 community-based exercise facilities in the Ottawa-Gatineau region, Canada.

Participants: 251 participants 39 to 70 years of age (mean age 54 y, 64% men) who had type 2 diabetes for > 6 months, had baseline HbA_{1c} levels of 6.6% to 9.9%, were previously inactive, and attended 10 to 12 exercise sessions in a 4-week run-in phase before randomization. Exclusion criteria included receipt of insulin therapy; ≥ 20 min/session of exercise ≥ 2 times/wk or resistance training in the past 6 months; changes in antihypertensive, lipid-lowering, or oral hypoglycemic medication; ≥ 5% change in body weight in the past 2 months; proteinuria > 1 g/d; serum creatinine level ≥ 200 μmol/L (≥ 2.26 mg/dL); and blood pressure (BP) > 160/95 mm Hg.

Intervention: Aerobic training (n = 60), resistance training (n = 64), aerobic plus resistance training (n = 64), or no exercise (n = 63). Participants in the 3 exercise groups received supervised training 3 times/wk for 22 weeks, with gradual progression in duration and intensity. Aerobic training consisted of exercises on treadmills or bicycle ergometers and progressed from 15 to 20 min/session at 60% maximum heart rate to 45 min/session at 75% maximum heart rate. Resistance training consisted of 7 different exercises per session using weight machines, and each exercise progressed to 2 to 3 sets at maximum weight lifted 7 to 9 times. All participants wore pedometers to measure background physical activity and were prescribed a diet for energy intake ≥ 90% of estimated weight maintenance requirements.

Outcomes: Included changes in HbA_{1c} level, body weight, waist circumference, BP, triglyceride, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and non–HDL cholesterol levels.

Patient follow-up: 88% (intention-to-treat analysis).

MAIN RESULTS

At 6 months, aerobic and resistance training alone each reduced HbA_{1c} levels more than no exercise; combined training reduced HbA_{1c} levels more than either aerobic or resistance training (Table). Aerobic training reduced body weight and waist circumference more than no exercise (Table); resistance training and no exercise did not differ; combined training did not differ from aerobic or resistance training. Groups did not differ for changes in BP or triglyceride, HDL, non-HDL, or LDL cholesterol levels.

CONCLUSION

Combined aerobic and resistance training was more effective than either alone for reducing hemoglobin A_{1c} levels in type 2 diabetes.

Sources of funding: Canadian Institutes of Health Research and Canadian Diabetes Association.

For correspondence: Dr. R.J. Sigal, University of Calgary, Calgary, Alberta, Canada. E-mail rsigal@ucalgary.ca.

*See Glossary.

†Information provided by author.

Comparisons of aerobic training, resistance training, combined training, and no exercise for type 2 diabetes‡

Outcomes at 6 mo	Mean change from baseline				Difference in change between groups (95% CI)
	Combined	Aerobic	Resistance	No exercise	
HbA_{1c} level (%)	–	–0.43	–	0.07	–0.51 (–0.87 to –0.14)
	–	–	–0.30	0.07	–0.38 (–0.72 to –0.22)
	–0.90	–0.43	–	–	–0.46 (–0.83 to –0.09)
	–0.90	–	–0.30	–	–0.59 (–0.95 to –0.23)
Body weight (kg)	–	–2.6	–	–0.3	–2.2 (–3.9 to –0.6)
Waist circumference (cm)	–	–3.0	–	–1.0	–2.1 (–4.1 to –0.2)

‡Hb = hemoglobin; CI defined in Glossary. Analysis based on a mixed-effects model and adjusted for age, sex, training site, and hypoglycemic medication.

COMMENTARY

Optimal management of type 2 diabetes includes exercise. The American Diabetes Association (1) recommends 150 min/wk of aerobic and resistance exercise. However, this recommendation does not address the issue of the incremental effect of combined aerobic and resistance exercises.

This well-designed study by Sigal and colleagues is an important contribution to the knowledge base on the incremental effects of combined aerobic and resistance exercise for glycemic control in type 2 diabetes. It overcame some of the challenges faced by behavior modification studies; however, participants were motivated volunteers who were given the incentive of a free gym membership, which is difficult to achieve in routine practice.

Of note, the combined group exercised twice as much as the aerobic or resistance training groups alone; thus, it is difficult to know whether the difference in HbA_{1c} change between the groups is because of the duration or the combination of exercise. The incremental effect of combined exercise on body composition, lipids, and BP was not significant; however, aerobic exercise reduced waist circumference more than no exercise.

Clinicians can be more confident about giving specific advice about exercise, especially on the incremental effect of aerobic and resistance training on improving glycemic control. The study also allows for estimation of the effect of exercise on glycemic control and shows that this effect is greater in persons with higher HbA_{1c} levels.

Kamlesh Bhargava, MD, MRCGP(INT)
Sultan Qaboos University
Muscat, Oman

Reference

1. **Sigal RJ, Kenny GP, White RR, et al.** ADA statement: physical activity/exercise and type 2 diabetes. Diabetes Care. 2006;29:1433-38.