Exercise Interventions for Diabetes Control: Do We Really Know That Strength Training Is Better Than Endurance Training?

Recently Cauza et al.1 compared the influence of strength training to endurance training on glycemic control, atherogenic markers, cardiovascular risk factors, body composition, strength, and cardiorespiratory endurance in people with diabetes. At first glance, results seemed clearly definitive that strength training was superior to endurance training. However, on closer inspection, the analysis strategy proposed in the methods section did not appear to be the analysis on which reported results were based. The risk in this is that conclusions of strength training superiority may be based on analyses that are insufficient to establish superiority.

The methods section indicated that 2-factor analysis of variance (ANOVA) was to be employed. Although not specified, presumably this was to be a mixed-model ANOVA comparing groups (strength vs endurance) by time of measurement (before vs after training). This would have been an appropriate analysis strategy, assuming that groups did not differ on relevant variables before training. Unfortunately, it appears that the analysis strategy employed neither followed this plan nor accounted for differences among groups before training on such important variables as plasma glucose levels and total cholesterol. The strength group had significantly poorer scores on each of these measures before training, allowing for a greater margin for change in post-training scores due to regression to the mean in combination with any effect of strength training. In fact, table 2 reveals strikingly poorer pretraining scores for the strength training group on blood glucose, plasma insulin, glycosylated hemoglobin (Hb A1c), insulin resistance, high-density and low-density lipoprotein cholesterol, and total cholesterol. A more appropriate analysis would have employed “before training” scores as a covariate in an analysis seeking differences among post-training means after adjustment for pretraining group differences. Analysis of covariance has long been recommended as a method to reduce bias when groups differ at baseline.2

To determine whether the results for the strength group had significantly poorer scores, Cauza et al. estimated from change scores that the strength group had significantly poorer scores on each of these measures before training, allowing for a greater margin for change in post-training scores due to regression to the mean in combination with any effect of strength training. In fact, table 2 reveals strikingly poorer pretraining scores for the strength training group on blood glucose, plasma insulin, glycosylated hemoglobin (Hb A1c), insulin resistance, high-density and low-density lipoprotein cholesterol, and total cholesterol. A more appropriate analysis would have employed “before training” scores as a covariate in an analysis seeking differences among post-training means after adjustment for pretraining group differences. Analysis of covariance has long been recommended as a method to reduce bias when groups differ at baseline.2

What is the risk in basing conclusions on analyses that, at best, are not adequately described and, at worst, result in analyses that favor 1 group over the other? Clinicians depend on the results of well-analyzed trials as evidence for patient care. I commend Cauza for using randomized methodology to study 2 clinically important interventions head-to-head. However, it remains unclear whether the differences in favor of strength training would exist when an analysis comparing groups simultaneously over time was employed. Without a more precise analysis, it would be premature for clinicians to recommend strength training over endurance training for patients with type 2 diabetes.

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References

The author responds
I would like to address the significant concerns raised by Douglas Weeks in relation to our study.

Because endurance training has been advocated as the most suitable exercise mode in type 2 diabetes (T2D), my colleagues and I wanted to compare the effects of strength training with the most effective exercise mode. Therefore, we used endurance training for the control group. We also intended to compare the effects of strength training with a second control group, a group without training, but our ethics committee had reservations about this approach. Because exercise is known to improve health in these patients, they felt that it would be unethical not to recommend exercise.

Perhaps endurance training with our intensity and volume in this study was less aggressive than strength training. Endurance training with an intensity of 60% of maximal oxygen consumption and a low (frequency) volume (starting at 15 min and advancing to a maximum of 30 min 3 times a week) was at the

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lower end of an endurance training program. We opted for this approach because of the extremely poor physical condition of our patients at study entry. All patients were untrained, so we had to start with low intensity and low volume.

The main aim of our study was to demonstrate that strength training is effective in T2D patients. We were able to show that strength training leads to benefits in glycemic and metabolic parameters and showed that strength training is neither dangerous nor ineffective. However, we agree with Weeks in that strength training in this study was not superior to endurance training but at least led to equal benefit.

Although all patients were carefully and correctly randomized, fasting blood glucose (FBG) and triglyceride values at study entry were significantly increased and glycosylated hemoglobin (Hb A1c) slightly (but insignificantly) increased in the strength training group.

All other parameters (including plasma insulin, all cholesterol values, blood pressure, and several measurements of body composition) did not differ significantly at study entry. It is known that values that are highly elevated and outside of a normative physiologic range can be reduced more easily than values that are closer to the normative range. Although the Hb A1c and FBG levels in the strength training group were higher and outside of physiologic range at study entry, the values were closer to normative levels than in the endurance training group after the 4-month training period. We observed similar effects for triglycerides, with nearly equal values in both groups after the training period.

The statistical analysis plan was developed by Heinz Tüchler, a statistician at the Ludwig Boltzmann Institute for Leukaemia Research and Haematology, before the study started. After consulting with him, multiple t tests were considered appropriate for this study design. In addition to the selected method, a statistical analysis using analysis of variance (ANOVA) was also identified as applicable to our study. Consequently, we changed the statistical evaluations and used ANOVA to examine differences in all parameters. The results of the ANOVA analysis were identical to the results of the t tests. Because the goal of our study was to show that strength training may be effective in T2D patients, our statistican used ANOVA to analyze the data.

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Reference

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