Iranian Society for Exercise Physiology

Endurance Training Improves Insulin Sensitivity and Induces Mitochondrial Adaptations in Type 2 Diabetes

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A new study from the University of Copenhagen reports that 12 weeks of supervised endurance training can improve insulin sensitivity and fat oxidation in people with type 2 diabetes. Researchers examined metabolic responses and skeletal muscle mitochondrial function in 29 participants with and without diabetes. The findings provide new insights into exercise-induced metabolic adaptations and their potential implications for exercise physiology and diabetes management.

Endurance Exercise and Metabolic Adaptations in Type 2 Diabetes

Type 2 diabetes is a common metabolic disorder characterized by impaired glucose regulation and insulin resistance. Regular physical exercise is an important non-

pharmacological intervention for improving metabolic health, although the mechanisms connecting endurance training, metabolic flexibility, and mitochondrial function remain incompletely understood.

A study conducted at the University of Copenhagen and published in the **Scandinavian Journal of Medicine & Science in Sports** investigated the effects of 12 weeks of supervised endurance training on insulin sensitivity, substrate metabolism, and skeletal muscle mitochondrial function in individuals with and without type 2 diabetes.

Study Design and Exercise Intervention

This non-randomized intervention study examined data from 15 individuals with type 2 diabetes and 14 participants without diabetes in its principal analyses.

Participants completed a 12-week supervised endurance training program consisting of three approximately 45-minute sessions per week.

Two weekly sessions involved stationary cycling, while the third used a rowing ergometer. Exercise intensity was individualized according to aerobic fitness and progressively adjusted throughout the intervention.

Before and after training, researchers assessed insulin sensitivity, metabolic flexibility, mitochondrial respiratory capacity, and mitochondrial hydrogen peroxide emission.

Improvements in Insulin Sensitivity

The results demonstrated increased insulin-stimulated glucose clearance following endurance training in both groups.

Statistical modeling indicated larger improvements among participants with type 2 diabetes, with a significant group-by-time interaction during the higher-insulin stage of the assessment.

These findings suggest that supervised endurance exercise can improve the physiological response to insulin even in individuals with established metabolic dysfunction.

Metabolic Flexibility and Mitochondrial Function

Metabolic flexibility describes the ability to adjust energy substrate utilization in response to changing physiological and metabolic conditions.

At baseline, participants with type 2 diabetes demonstrated reduced flexibility related to

fat metabolism. Following the intervention, this aspect of metabolic flexibility improved modestly.

Interestingly, baseline mitochondrial respiratory capacity did not differ substantially between groups.

After training, researchers observed reductions in selected measures of mitochondria-specific respiration and hydrogen peroxide emission when normalized to mitochondrial activity markers.

These findings indicate mitochondrial adaptations to endurance training, although further investigation is required to determine their precise implications for mitochondrial efficiency and oxidative stress.

Implications for Exercise Physiology

The study provides evidence that improvements in insulin sensitivity and fat oxidation can occur without detectable baseline impairments in intrinsic mitochondrial respiratory capacity.

It also highlights the importance of evaluating multiple physiological dimensions when investigating exercise adaptations in people with type 2 diabetes.

However, the relatively small sample size, non-randomized design, and 12-week intervention period limit the generalizability of the findings.

The results should therefore not be interpreted as demonstrating the superiority of this specific exercise protocol over other training approaches.

Overall, the research contributes to understanding how endurance exercise influences metabolic regulation and skeletal muscle physiology, providing a foundation for future studies on individualized exercise interventions in type 2 diabetes.

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