



Exercise and Glucose Regulation in Type 2 Diabetes: A Systematic Review of Mechanisms and Pathways

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Abstract

Background: Hyperglycaemia and insulin resistance are key characteristics of type 2 diabetes mellitus, a chronic metabolic disorder often leading to complications such as cardiovascular disease, neuropathy, and retinopathy. While insulin therapy and other glucose-lowering medications are widely used, some individuals exhibit poor responsiveness, necessitating alternative strategies to improve glycaemic control. Exercise has been shown to enhance glucose metabolism, yet the mechanisms behind its effectiveness in insulin-resistant individuals remain an area of interest. This systematic review explores how, in the absence of effective insulin therapy, exercise contributes to glucose regulation. The focus is on physiological, molecular, and cellular pathways that mediate these effects.

Methods: A structured search strategy was applied using the terms Exercise, Glucose Transporter Type 4 (GLUT4), and Type 2 Diabetes Mellitus. Relevant literature from 2009 to 2023 was retrieved from PubMed, Google Scholar, and the Cochrane Library. Studies investigating the impact of exercise on glucose metabolism in type 2 diabetes were included, while those involving children, pregnant women, individuals with type 1 diabetes, or other metabolic disorders were excluded.

Results: The analysis revealed that various forms of physical activity significantly improved glycaemic control, insulin sensitivity, and glucose uptake. A consistent association was observed between regular exercise and reductions in HbA1c, insulin resistance, and fasting glucose levels. Aerobic exercise, resistance training, and combined regimens demonstrated notable improvements in metabolic parameters. These findings highlight the role of structured exercise programs as an effective strategy for blood sugar management and overall well-being in individuals with type 2 diabetes. Furthermore, some studies suggest that exercise facilitates glucose metabolism through mechanisms independent of insulin signalling.

Conclusions: Exercise plays a critical role in improving glucose regulation through multiple pathways in type 2 diabetes. Further research is needed to refine exercise protocols and address barriers to adherence. As part of a comprehensive management plan, incorporating exercise alongside medication and lifestyle modifications offers a safe and effective approach to glycaemic control.

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