

Nutritional interventions and metabolic reprogramming: Strategies for managing type 2 diabetes.

Antonio Colagiuri*

Department of Pediatrics and Adolescent Medicine, University of Sydney, Australia

*Correspondence to: Antonio Colagiuri, Department of Pediatrics and Adolescent Medicine, University of Sydney, Australia, E-mail: acolagiuri@sydney.edu.au

Received: 01-Jan-2025, Manuscript No. JGDD-25-167213; Editor assigned: 02-Jan-2025, Pre QC No. JGDD-25-167213 (PQ); Reviewed: 15-Jan-2025, QC No. JGDD-25-167213; Revised: 20-Jan-2025, Manuscript No. JGDD-25-167213 (R); Published: 27-Jan-2025, DOI: 10.35841/JGDD-10.1.246

Introduction

Type 2 diabetes affects hundreds of millions worldwide and is driven by a combination of genetic, environmental, and lifestyle factors. The hallmark pathophysiology involves insulin resistance in peripheral tissues and beta-cell dysfunction in the pancreas. As the disease progresses, complications such as cardiovascular disease, nephropathy, and neuropathy become more likely. Dietary interventions, when correctly implemented, have shown potential not only to control blood sugar but also to reprogram metabolism—restoring cellular function and reducing the dependency on medication.[1].

Metabolic reprogramming refers to the process of modifying cellular pathways to restore healthy energy utilization, particularly relevant in type 2 diabetes mellitus (T2DM), where cells experience altered glucose and lipid metabolism, increased oxidative stress, and mitochondrial dysfunction. Nutritional strategies can help reverse or mitigate these metabolic abnormalities by enhancing insulin sensitivity, reducing hepatic glucose output, modulating gut microbiota, promoting autophagy and mitochondrial repair, and improving beta-cell function. This metabolic shift is especially influenced by macronutrient composition, meal timing, and caloric intake.[2].

Key nutritional interventions for managing metabolic health include low-carbohydrate and ketogenic diets, as well as the Mediterranean diet. Low-carb and ketogenic diets, which restrict carbohydrate intake (particularly <50g/day in ketogenic approaches), reduce postprandial hyperglycemia and insulin

secretion, shifting the body toward fat oxidation and ketone production. These dietary strategies improve insulin sensitivity, decrease triglycerides, increase HDL, reductions in HbA1c levels and even achieve remission of type 2 diabetes mellitus (T2DM) under proper medical supervision. On the other hand, the Mediterranean diet—characterized by high consumption of whole grains, olive oil, legumes, fruits, and fish—offers a low glycemic load and is rich in antioxidant and anti-inflammatory nutrients. It also improves lipid profiles and positively modulates the gut microbiome, making it another effective approach for metabolic health management [3].

One of the most evidence-based diets for cardiovascular health in diabetics is the plant-based diet, which emphasizes vegetables, fruits, legumes, nuts, and whole grains. Such diets are associated with improved insulin sensitivity, lower body mass index (BMI), and reduced markers of systemic inflammation. Fiber-rich foods in these diets help blunt blood sugar spikes and promote satiety, supporting weight management. Another dietary approach gaining attention is Intermittent Fasting (IF), which involves alternating periods of eating and fasting, such as the 16:8 method (16 hours of fasting followed by an 8-hour eating window). IF has been shown to lower fasting insulin and glucose levels, enhance fat content. Some studies suggest that IF may replicate the metabolic benefits of calorie restriction while offering better long-term adherence [4].

Micronutrient support plays a vital role in glucose control, with nutrients such as magnesium improving insulin receptor activity

and reducing insulin resistance, vitamin D modulating insulin secretion and inflammation, chromium enhancing insulin action and glucose uptake, and omega-3 fatty acids helping to reduce triglycerides and inflammation. Supplementation may be beneficial for individuals with deficiencies to support overall metabolic health. Furthermore, sustained weight loss—even as little as 5–10% of body weight—can significantly improve glucose control, reduce blood pressure, and lower LDL cholesterol levels. Very low-calorie diets (VLCDs), typically providing less than 800 kcal/day and used under medical supervision, have shown promise in inducing remission of type 2 diabetes in several clinical studies [5].

Conclusion

Nutritional intervention is a cornerstone of Type 2 diabetes management and, when optimized, can reprogram key metabolic pathways to improve or even reverse disease progression. From low-carb and Mediterranean diets to intermittent fasting and micronutrient therapy, a range of dietary strategies offers powerful, drug-sparing options. Personalized, evidence based approaches that consider individual physiology, preferences, and lifestyle are essential to harnessing the full benefits of nutrition in managing diabetes.

References

1. Pointel JP, Boccalon H, Cloarec M, et al. Titrated extract of *Centella asiatica* (TECA) in the treatment of venous insufficiency of the lower limbs. *Angiology*. 1987; 38(1):46-50.
2. Arpaia MR, Ferrone R, Amitrano M, et al. Effects of *Centella asiatica* extract on mucopolysaccharide metabolism in subjects with varicose veins. *Int J Clin Pharmacol*. 1990;10(4):229-33.
3. Belcaro GV, Grimaldi R, Guidi G. Improvement of capillary permeability in patients with venous hypertension after treatment with TTFCA. *Angiology*. 1990;41(7):533-40.
4. Montecchio GP, Samaden A, Carbone S, et al. *Centella Asiatica* Triterpenic Fraction (CATTF) reduces the number of circulating endothelial cells in subjects with post phlebotic syndrome. *Haematologica*. 1991;76(3):256-9.
5. Cataldi A, Gasbarro V, Viaggi R, et al. Effectiveness of the combination of alpha tocopherol, rutin, melilotus, and *centella asiatica* in the treatment of patients with chronic venous insufficiency. *Minerva Cardioangiol*. 2001;49(2):159-63.