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The Role of Different Dietary Models in Medical Nutrition Therapy for Type 1 and Type 2 Diabetes: From Past to Present

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Abstract: Medical nutrition therapy (MNT) is a fundamental component that complements pharmacological treatment in the management of both type 1 and type 2 diabetes. However, current evidence indicates that there is no single ideal diet suitable for everyone and that the nutritional approach should be individualized. In this review, the role of different dietary models in the medical nutrition therapy of type 1 and type 2 diabetes management is evaluated-on the basis of current guidelines and meta-analyses predominantly from the 2020–2026 period-in terms of their definitions and mechanisms of action, glycemic and cardiometabolic evidence bases, applicability in the two types of diabetes, sustainability dimensions, and safety and adherence. The models addressed include the Mediterranean diet, DASH, low- and very-low-carbohydrate (ketogenic) diets, the low glycemic index/load approach, plant-based (vegetarian, vegan, and Portfolio) diets, high-protein/moderate-carbohydrate approaches, intermittent fasting and time-restricted eating, and very-low-energy diets targeting type 2 diabetes remission. Current evidence shows that multiple dietary patterns significantly improve glycemic control, that this benefit is largely mediated by weight loss, and that the decisive factor in long-term success is the sustainability of adherence rather than the type of model. In type 2 diabetes, energy balance, weight loss, and-in suitable individuals-remission are prominent, whereas in type 1 diabetes, carbohydrate counting and insulin-dose matching are of primary importance. Furthermore, it is notable that the dietary patterns strongly recommended for health (the Mediterranean, low glycemic index, and plant-based diets) overlap with the most environmentally sustainable models. In conclusion, in the management of diabetes, evidence-based dietary models should be individualized and sustained with long-term professional support.

Keywords: Diabetes management; Dietary models; Medical nutrition therapy; Glycemic control; Dietary patterns

Introduction

The role of nutrition in diabetes management is intertwined with the history of the disease itself. In the pre-insulin era, diet was the only available treatment; in the early twentieth century, Frederick M. Allen and Elliott P. Joslin employed severe carbohydrate- and energy-restricted regimens—also referred to as "starvation diets"—to reduce glycosuria and prolong survival (Mudaliar, 2023). With the discovery of insulin in 1921, nutrition therapy shifted from being the sole treatment to a component complementing pharmacological therapy (Mudaliar, 2023). During this period, to bring consistency to meal planning, the exchange lists were developed in 1950 through the collaboration of the American Dietetic Association, the American Diabetes Association, and the U.S. Public Health Service, providing a standardized meal-planning tool in which foods of similar nutritional value could be substituted for one another. It was subsequently recognized that not only the quantity but also the quality of carbohydrate matters; in 1981, Jenkins and colleagues introduced the concept of the glycemic index, classifying carbohydrate-containing foods according to their postprandial blood glucose response (Jenkins et al., 1981).

From the 1980s onward, the principle of individualization replaced a single prescriptive diet (American Diabetes Association Professional Practice Committee [ADA], 2026), and the focus shifted from single nutrients to

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evidence-based dietary patterns (e.g., Mediterranean, DASH). More recently, newer dimensions such as type 2 diabetes remission through energy restriction (Lean et al., 2018) and the environmental sustainability of nutrition (Willett et al., 2019) have come to the fore. This historical trajectory explains why contemporary medical nutrition therapy relies on individualized, evidence-based dietary models rather than a single "ideal diet."

Medical nutrition therapy (MNT) is a fundamental component that complements pharmacological treatment in the management of both type 1 and type 2 diabetes, current guidelines recommend planning MNT as an individualized approach rather than a single standard prescription (American Diabetes Association Professional Practice Committee [ADA], 2026; Society of Endocrinology and Metabolism of Turkey [TEMD], 2026). The ADA 2026 Standards emphasize that there is no single ideal macronutrient distribution applicable to everyone instead, they highlight dietary patterns focused on nutritional quality that prioritize non-starchy vegetables, whole grains, legumes, nuts, and lean protein sources while limiting refined and ultra-processed foods and sugar-sweetened beverages (ADA, 2026).

When dietary models are examined comparatively, it becomes evident that—rather than there being a single superior model—multiple dietary patterns yield significant improvements in glycemic control. A meta-analysis comprising forty-two randomized controlled trials reported that ketogenic, low-carbohydrate, and low-fat diets significantly reduced HbA1c levels, while moderate-carbohydrate, low-glycemic index, Mediterranean-style, and high-protein diets significantly lowered fasting glucose levels compared to control groups however, the reductions in both HbA1c and fasting glucose were statistically associated solely with weight change (Jing et al., 2023). Another meta-analysis comparing eight different dietary approaches in overweight and obese individuals with type 2 diabetes confirmed that Mediterranean, low-carbohydrate, and low-glycemic index patterns stood out in terms of glycemic control and weight loss (Yuan et al., 2024). These findings indicate that, alongside efficacy, individual adherence and the impact on body weight are decisive factors in the selection of a dietary model.

The priorities of nutritional therapy differ somewhat between type 1 and type 2 diabetes. In type 2 diabetes, the focus is on energy balance, weight loss, and the goal of remission through adequate early intervention (Lean et al., 2018). In type 1 diabetes, however, nutrition is planned in coordination with insulin therapy, and the impact of carbohydrate counting and macronutrient composition on insulin dosage and glycemic fluctuations is of central importance (ADA, 2026; Holt et al., 2021). Indeed, the 2026 ADA revisions have expanded the evidence regarding the influence of macronutrient composition on insulin dose determination and glycemic variability, particularly in children and adolescents (ADA, 2026).

Method

This study is a traditional review addressing various dietary patterns used in the medical nutrition therapy of type 1 and type 2 diabetes. The review is based on current clinical practice guidelines (e.g., American Diabetes Association, Society of Endocrinology and Metabolism of Turkey, and Turkey Nutrition Guide) and peer-reviewed literature published primarily between 2020 and 2026. Sources were accessed via PubMed, Scopus, and Web of Science databases using combinations of keywords such as "diabetes mellitus," "type 1 diabetes," "type 2 diabetes," "medical nutrition therapy," "dietary pattern," "Mediterranean diet," "DASH," "low-carbohydrate/ketogenic diet," "glycemic index," "plant-based diet," "intermittent fasting," "very-low-energy diet," and "diabetes remission."

Priority was given to meta-analyses, systematic reviews, randomized controlled trials, and guidelines; a limited number of older studies foundational to the field were utilized as historical references where appropriate. The selected dietary patterns were examined comparatively in terms of their definitions and mechanisms of action, glycemic and cardiometabolic evidence bases, applicability to type 1 and type 2 diabetes, sustainability, safety, and adherence. As the review does not involve primary data, ethics committee approval was not required.

General Principles and Goals of Nutritional Therapy in Type 1 And Type 2 Diabetes

Goals of Nutritional Therapy

The primary goals of medical nutrition therapy in diabetes are to improve the individual's glycemic control, support achievable and sustainable weight goals, and positively influence cardiometabolic risk markers—such as blood pressure and lipid profiles—while taking into account the individual's quality of life, cultural preferences, and access to food (ADA, 2026; TEMD, 2026). Current guidelines recommend initiating nutrition therapy at the time of diagnosis and re-evaluating it at regular intervals, preferably with the guidance of a registered dietitian (ADA, 2026). Central to this approach is the principle of planning dietary patterns tailored to the individual, rather than relying on a single, standardized prescription (TEMD, 2026).

Macronutrient Distribution and Nutritional Quality

It is considered that there is no single ideal distribution of carbohydrates, fats, and proteins suitable for all individuals with diabetes (Jing et al., 2023). Therefore, macronutrient ratios should be determined based on the individual's metabolic goals, treatment regimen, and preferences. However, the quality of macronutrients is just as critical as the quantity. There are significant differences in health impacts between carbohydrate sources such as legumes, whole grains, and whole fruits versus refined grains (Chiavaroli et al., 2021).

Current recommendations emphasize prioritizing non-starchy vegetables, whole grains, legumes, nuts, lean protein sources, and low-fat dairy products, while minimizing refined grains, sugar-sweetened beverages, sweets, and processed or ultra-processed foods (ADA, 2026; TEMD, 2026). It is recommended to maintain fiber intake at a level of at least 14 g/1000 kcal, choose water over sugar-sweetened beverages, and use non-nutritive sweeteners only in the short term and in moderation (ADA, 2026). Modestly reducing carbohydrate intake can contribute to glycemic control in some adults (Jing et al., 2023).

Principles Specific to Type 1 Diabetes: Carbohydrate Counting and Insulin-Dose Matching

In type 1 diabetes, nutritional therapy is planned in coordination with insulin therapy, and carbohydrate counting is accepted as the standard method for determining mealtime insulin doses (Holt et al., 2021). However, carbohydrate content alone does not fully account for postprandial glycemia in mixed meals. It has been shown that dietary fat and protein also contribute to delayed postprandial glucose excursions and that this effect is additive (Al Balwi et al., 2022). Meals high in fat and protein can lead to a prolonged glycemic rise occurring 1.5 to 6 hours post-meal by delaying gastric emptying and increasing insulin requirements (Faggionato et al., 2026).

Consequently, current approaches recommend adjusting insulin doses based on macronutrient composition for selected meals using fat-protein unit-based algorithms or extended/dual-wave bolus strategies (Holt et al., 2021; Al Balwi et al., 2022). A randomized study reported that a modified fat-protein unit algorithm reduced mean glucose levels during the late postprandial phase (240–300 minutes) by approximately 1.1 mmol/L compared to carbohydrate counting for meals high in protein and fat, without increasing the frequency of hypoglycemia (Cai et al., 2023). The widespread adoption of continuous glucose monitoring and automated/hybrid closed-loop insulin systems is making these individualized dose adjustments increasingly feasible (Faggionato et al., 2026).

Principles Specific to Type 2 Diabetes: Energy Balance, Weight Loss, and Remission

Energy balance and clinically significant weight loss are the defining components of nutritional therapy for type 2 diabetes (Churuangsuk et al., 2022). Glycemic and cardiometabolic improvements appear to occur largely through weight change (Jing et al., 2023). In recent years, type 2 diabetes has come to be recognized as a potentially reversible process capable of entering remission (normoglycemia without the use of antidiabetic medication) through sufficient and early weight loss (Riddle et al., 2021).

In the primary care-based DiRECT trial, remission was achieved in 46% of participants in the group undergoing a structured intensive weight management program at 12 months—compared to 4% in the control group—with approximately one-quarter of individuals in the intervention group losing 15 kg or more (Lean et al., 2018). Two-year follow-up data demonstrated that remission was maintained in more than one-third of participants and that the maintenance of remission was directly associated with the magnitude of weight loss achieved (Lean et al., 2019). These findings highlight that, beyond mere efficacy, the dimension of adherence—which enables the sustainability of an energy deficit and weight loss—is of critical importance when selecting a dietary pattern for type 2 diabetes.

Integrating the Sustainability Dimension into Nutritional Therapy

When evaluating dietary patterns for diabetes management, it is becoming increasingly important to consider the environmental burden of dietary habits alongside individual health outcomes. On a global scale, human nutrition is responsible for approximately one-third of greenhouse gas emissions, half of land use, about 70% of freshwater consumption, and a significant portion of biodiversity loss (Willett et al., 2019). In this context, the "planetary health diet"—proposed by the EAT-Lancet Commission in 2019—aims to optimize both human health and environmental sustainability, it serves as a reference pattern that prioritizes plant-based sources, is rich in whole grains, vegetables, fruits, legumes, and nuts, and limits red meat and added sugars. Analyses combining numerous prospective cohort studies demonstrate that high adherence to this pattern is associated with a reduced risk of all-cause mortality, cardiovascular disease, and type 2 diabetes, while also aligning with a lower environmental impact (Wang et al., 2025).

A crucial point regarding diabetes is the significant overlap between evidence-based dietary patterns recommended for health (such as Mediterranean and plant-based diets) and environmentally sustainable patterns (Lorca-Camara et al., 2024). This suggests that the clinical and ecological goals of nutritional therapy can often align. A cross-sectional study conducted in Türkiye with individuals having type 2 diabetes also highlights the relevance of this topic within the local context by examining the relationship between adherence to this pattern and health parameters (Karabicak & Yuksel, 2025). However, it should be noted that adherence levels vary depending on the population and the scoring systems used; therefore, recommendations need to be individualized, taking into account cultural and economic accessibility.

The Turkish Context and National Guidelines

In addition to international evidence regarding dietary patterns for diabetes, it is crucial to consider the national guidelines that shape clinical practice in Türkiye. The current diabetes guideline of the Society of Endocrinology and Metabolism of Turkey (TEMD) identifies medical nutrition therapy as a fundamental component of diabetes management. It offers recommendations largely consistent with international guidelines regarding individualized energy and macronutrient planning, weight management, and the prioritization of healthy eating patterns—particularly the Mediterranean diet (Turkish Diabetes Foundation [TÜRKDİAB], 2025; TEMD, 2026).

Similarly, the Turkey Nutrition Guide (TÜBER) 2022 aligns directly with the dietary patterns and sustainability aspects discussed in this review, covering food-based recommendations, the healthy eating plate model, and portion-based approaches, as well as plant-based nutrition, popular diets, and sustainable nutrition (Republic of Türkiye Ministry of Health [TÜBER], 2022). These national resources provide a vital framework for adapting international evidence to the dietary culture, accessibility conditions, and palate of the Turkish population (Karabicak and Yuksel, 2025). Therefore, selecting a dietary pattern for diabetes management yields the most effective results when it integrates international evidence with national guideline recommendations and adapts them to the local context.

Dietary Models in Diabetes Management

Different dietary models used in the medical nutrition therapy for Type 1 and Type 2 diabetes are evaluated comparatively in terms of their key characteristics, potential mechanisms of action, current evidence regarding glycemic and cardiometabolic outcomes, as well as feasibility, long-term sustainability, safety, and adherence. A comparative overview of these dietary models is presented in Table 1.

Table 1. Comparison of different dietary models in the management of type 1 and type 2 diabetes

Dietary Model	Role in T1DM	Role in T2DM	Main Benefits	Limitations/Safety Considerations
Mediterranean diet	Evidence is limited, may be used as a complementary approach alongside carbohydrate counting and insulin-dose	Stronger evidence supports its use for glycemic and cardiometabolic management	Improves glycemic control and cardiometabolic risk profile, favorable long-term adherence and environmental	Adherence may be affected by socioeconomic, cultural, accessibility, and cost-related factors

	matching		sustainability	
DASH diet	Direct evidence is limited, may be implemented as a complementary approach, particularly when cardiovascular risk is present	Supports glycemic control and blood pressure management	Improves glycemic control, blood pressure, and overall cardiovascular risk profile	Carbohydrate intake should be individualized; adherence may be influenced by sodium restriction, accessibility, and food preferences
Low- and very-low-carbohydrate diets	Evidence is limited, ketogenic approaches are not routinely recommended, particularly in children and adolescents	May improve short-term glycemic control and support weight loss and medication reduction	Reduces postprandial glucose excursions and may lower insulin requirements and body weight	Risk of hypoglycemia, ketoacidosis, dyslipidemia, LDL-C elevation, nutrient inadequacy, and poor long-term adherence
Low-GI/GL diet	May complement carbohydrate counting and reduce postprandial glycemic excursions	Supports glycemic control and cardiometabolic risk management	Improves postprandial glycemia and HbA1c, generally safe and feasible	GI values vary according to processing, cooking, and meal composition; low GI does not necessarily indicate high nutritional quality
Plant-based diets	Evidence is limited, feasible with appropriate dietary planning and carbohydrate–insulin matching	Supports glycemic control, weight management, and cardiometabolic health	Potential improvements in HbA1c, body weight, and lipid profile; high environmental sustainability	Nutritional adequacy must be monitored, vitamin B_{12} and other micronutrients may require particular attention
High-protein / moderate-carbohydrate approaches	Direct evidence is limited, higher protein intake may contribute to delayed postprandial glucose elevations	May support weight management and cardiometabolic health	May improve satiety, body composition, and selected metabolic parameters	Kidney function must be considered; high protein intake should be avoided in diabetic kidney disease
Intermittent fasting / time-restricted eating	Not routinely recommended because of hypoglycemia, hyperglycemia, and ketoacidosis risks	May be considered in selected individuals, particularly for weight and glycemic management	May reduce energy intake, body weight, fasting glucose, and HbA1c	Requires medication adjustment and close glucose monitoring; benefits may be largely related to energy restriction and weight loss
Very-low-energy diets	Not recommended as a therapeutic dietary strategy	May induce substantial weight loss and support remission in selected individuals	Major weight loss and potential type 2 diabetes remission	Requires medical supervision, medication adjustment and long-term weight maintenance are essential

Mediterranean Diet

The Mediterranean diet is a plant-based dietary pattern characterized by the abundant consumption of vegetables, fruits, whole grains, legumes, nuts, and fish—with olive oil serving as the primary source of fat—while limiting red and processed meats and products with added sugars. Its potential beneficial effects on diabetes are attributed to multifaceted mechanisms, including high levels of monounsaturated fatty acids and fiber, a low glycemic load, the antioxidant and anti-inflammatory contributions of polyphenols and other bioactive compounds, and positive modulation of the gut microbiota. These characteristics can contribute to improved insulin sensitivity and a reduction in postprandial glycemic fluctuations (Nani et al., 2021; Wu et al., 2025).

Various studies support the glycemic and cardiometabolic benefits of the Mediterranean diet in adults with type 2 diabetes. Meta-analyses have reported that the Mediterranean diet reduces HbA1c by 0.31–0.39%, fasting plasma glucose by 0.85 mmol/L, and body mass index by 0.83 kg/m^2, while also improving LDL cholesterol and blood pressure (Zheng et al., 2024; Wu et al., 2025). It has been shown that each 1-point increase in the Mediterranean Diet Score is associated with an approximately 0.13% reduction in HbA1c (Vavitis et al., 2026), and that high adherence to the diet reduces the risk of developing type 2 diabetes by approximately 21% over a 20-year follow-up period (Kechagia et al., 2024). These findings support the Mediterranean diet as an evidence-based dietary pattern for the prevention and management of type 2 diabetes.

Although evidence regarding the Mediterranean diet in type 1 diabetes is more limited compared to type 2 diabetes, positive findings exist. A prospective intervention study conducted on adolescents demonstrated an increase in time in range from 52% to 63% and a reduction in diastolic blood pressure (Levran et al., 2023). Studies involving children and adolescents also support the finding that high adherence to the diet is associated with better glycemic control (Dominguez-Riscart et al., 2022). However, current evidence is insufficient to recommend the Mediterranean diet as a standalone nutritional model for type 1 diabetes. Therefore, it appears more appropriate to implement it as a complementary nutritional model that supports glycemic control and cardiometabolic health, alongside carbohydrate counting and the matching of insulin doses to food intake.

In addition to its clinical benefits, the Mediterranean diet is a dietary model that offers advantages regarding environmental sustainability. Findings from systematic reviews indicate that, compared to Western-style diets, it is associated with lower greenhouse gas emissions (1.03–5.08 kg CO_2-equivalent/person/day), water footprint, and land use furthermore, approximately 91% of the studies evaluated it as a sustainable model (Lorca-Camara et al., 2024). The emphasis on plant-based foods and limited red meat consumption contributes to reducing the environmental impact of the Mediterranean diet. With these characteristics, the Mediterranean diet stands out as a dietary model that simultaneously supports clinical benefits in diabetes management and environmental sustainability.

The Mediterranean diet is a dietary pattern that is generally safe, nutritionally adequate, and suitable for long-term adherence. However, methodological differences across studies complicate the interpretation of findings. Furthermore, adherence to the diet is influenced by socioeconomic status, access to food, and cultural characteristics. Therefore, in clinical practice, it is important to personalize the Mediterranean diet based on local dietary habits, cost, accessibility, and individual preferences.

DASH Diet

The Dietary Approaches to Stop Hypertension (DASH) diet is a dietary pattern rich in vegetables, fruits, whole grains, and low-fat dairy products it includes poultry, fish, nuts, and legumes while limiting red meat, sugar-sweetened beverages, sweets, and total sodium intake. Although originally developed to lower blood pressure, its high content of potassium, magnesium, calcium, and fiber—combined with a low profile of saturated fat and sodium—also yields positive effects on insulin sensitivity, endothelial function, and overall cardiometabolic risk (Liu et al., 2025). With these characteristics, the DASH diet offers a holistic approach to managing hypertension and dyslipidemia—conditions that frequently coexist with diabetes—in addition to supporting glycemic control.

The diabetes-adapted DASH (DASH4D) diet has been shown to have positive effects on glycemic control in individuals with type 2 diabetes. In a randomized crossover study, DASH4D reduced mean glucose by 11.1 mg/dL and increased time in target range by 5.2 percentage points compared to a Western-style diet (Fang et al., 2025). Additionally, reductions of 5.6 µmol/L in fructosamine levels, 4.5 mg/dL in fasting plasma glucose, and 0.09 percentage points in HbA1c were observed (Fang et al., 2026). Meta-analyses also support the DASH diet as a dietary pattern that improves glycemic control (Jing et al., 2023). Given its blood pressure-lowering effects, the DASH diet is considered a beneficial dietary approach for glycemic control and cardiovascular risk management in type 2 diabetes.

Evidence regarding the DASH diet is primarily based on individuals with type 2 diabetes, demonstrating that this dietary pattern supports glycemic control and blood pressure management (Liu et al., 2025). However, direct evidence concerning type 1 diabetes is limited. Nevertheless, considering cardiovascular risk, DASH principles can be implemented as a complementary approach alongside carbohydrate counting and the adjustment of insulin doses to match nutrient intake. Further studies are needed to determine its efficacy in type 1 diabetes (Filippou et al., 2020).

Due to its emphasis on plant-based foods, the DASH diet is associated with a lower environmental impact compared to the Western diet. Studies indicate that the DASH diet, alongside the Mediterranean diet and current healthy eating patterns, ranks among sustainable dietary options (Frank et al., 2024). However, its emphasis on dairy products somewhat limits its environmental sustainability. Increasing the intake of plant-based protein sources contributes to reducing the environmental footprint of the DASH diet.

The DASH diet is generally considered a safe, nutritionally adequate, and well-tolerated dietary pattern. For individuals with diabetes, carbohydrate intake must be adjusted to meet glycemic targets; the DASH4D diet offers an option adapted to this requirement. Long-term adherence is influenced by factors such as sodium restriction, access to foods, and individual preferences. Therefore, personalizing the DASH diet to align with glycemic and blood pressure targets is recommended.

Low-Carbohydrate and Very Low-Carbohydrate (Ketogenic) Diets

In low-carbohydrate diets, carbohydrate intake is generally kept below 26% of total energy (approximately ≤130 g/day), whereas in very low-carbohydrate/ketogenic diets, it is maintained at a level of ≤50 g/day or ≤10% of total energy (Bolla et al., 2019). Carbohydrate restriction reduces postprandial glucose excursions and insulin requirements. Restriction at ketogenic levels, meanwhile, promotes the use of fats as the primary energy source, thereby inducing nutritional ketosis. The positive effects on glycemic control are attributed to reduced glucose fluctuations, weight loss, and improved insulin sensitivity (Bolla et al., 2019).

Carbohydrate restriction in type 2 diabetes is reported to improve glycemic control, particularly in the short term. Meta-analyses show reductions in HbA1c levels corresponding to a standardized mean difference of approximately −1.45 with ketogenic diets and −0.27 with low-carbohydrate diets (Zaki et al., 2022). However, studies lasting 12 months or longer do not demonstrate a significant superiority over control diets regarding HbA1c, body weight, blood pressure, or LDL cholesterol (Parry-Strong et al., 2022; Ichikawa et al., 2024). It is noted that glycemic improvement is significantly associated with weight loss (Jing et al., 2023). While some studies report improvements in triglyceride and HDL cholesterol levels, an increase in LDL cholesterol associated with high saturated fat intake poses a potential risk. Therefore, carbohydrate restriction is considered an effective option in the short and medium term, whereas its long-term efficacy is influenced by dietary adherence and sustainability.

In type 2 diabetes, carbohydrate restriction is viewed as an option that supports weight loss and a reduction in medication requirements under medical supervision. In type 1 diabetes, although positive effects on glycemic control and insulin requirements have been reported, the evidence remains limited (Bolla et al., 2019). Diabetic ketoacidosis, hypoglycemia, and dyslipidemia constitute the primary safety risks, and there are additional concerns regarding growth and bone health in children (Rydin et al., 2021). For this reason, the ketogenic diet is not routinely recommended, particularly for children and adolescents with type 1 diabetes if implemented, it requires close clinical monitoring, ketone tracking, insulin dosage adjustments, and patient education (Rydin et al., 2021).

Ketogenic and low-carbohydrate diets are classified as dietary patterns with a high environmental impact due to the high consumption of animal-based foods. It has been reported that the ketogenic diet is associated with approximately 3 kg of CO_2-equivalent emissions per 1000 kilocalories and is considered to have low sustainability (O'Malley et al., 2023). However, studies show that environmental impact varies depending on food choices and that opting for plant-based sources of fat and protein can reduce carbon emissions. Therefore, prioritizing plant-based sources when restricting carbohydrates contributes to supporting both cardiometabolic and environmental sustainability.

Key limitations associated with carbohydrate restriction include increases in LDL cholesterol, inadequate intake of fiber and micronutrients, and difficulties with long-term adherence. Individuals using insulin or insulin-secretagogue medications require dosage adjustments to mitigate the risk of hypoglycemia. A more cautious approach is recommended for type 1 diabetes, childhood, and pregnancy due to the risk of ketoacidosis and other potential complications (Rydin et al., 2021). Consequently, carbohydrate restriction should be implemented under medical supervision, with due regard for nutritional quality and personalization based on individual needs.

Low Glycemic Index/Glycemic Load Diet

The low glycemic index (GI) and glycemic load (GL) approach prioritizes foods that elicit a lower glycemic response—such as legumes, whole grains, vegetables, and whole fruits—while limiting refined grains and products with added sugar. By slowing the digestion and absorption of carbohydrates, this approach reduces postprandial glucose and insulin fluctuations and supports glycemic control through high fiber content (Augustin et al., 2015; Chiavaroli et al., 2021).

A systematic review and meta-analysis involving 1.617 participants with type 1 and type 2 diabetes reported that low GI/GL diets reduced HbA1c by an average of 0.31% and had beneficial effects on fasting glucose, LDL and non-HDL cholesterol, apolipoprotein B, triglycerides, body weight, body mass index, systolic blood pressure, and C-reactive protein (Chiavaroli et al., 2021). Other meta-analyses also support the benefits of this approach for glycemic control (Jing et al., 2023). However, it is noted that findings regarding lipid profiles and long-term outcomes are more limited and variable (Peres et al., 2023).

The low GI/GL approach is considered applicable to both type 1 and type 2 diabetes (Chiavaroli et al., 2021). In type 2 diabetes, it supports improvements in glycemic control and cardiometabolic risk factors. In type 1 diabetes, it contributes to reducing postprandial glucose fluctuations by complementing carbohydrate counting. Due to its safe and feasible nature, it is considered part of nutritional therapy for both types of diabetes.

Legumes, whole grains, vegetables, and fruits—which feature prominently in the low-GI/GL approach—are among the foods with a low environmental impact. Legumes, in particular, support environmental sustainability through their low carbon, water, and land footprints (Drewnowski & Conrad, 2024). Consequently, the low-GI/GL approach contributes to reducing the environmental impact of the diet in addition to improving glycemic control.

The low-GI/GL approach is generally considered safe and nutritionally adequate. However, the fact that GI values can vary based on factors such as processing, cooking methods, and food composition complicates its implementation. Furthermore, it is noted that a low GI value does not inherently indicate high nutritional quality, and inconsistencies across studies limit the interpretation of the evidence. Therefore, it is recommended that the approach be implemented with due regard for overall nutritional quality, prioritizing whole or minimally processed foods.

Plant-Based Diets (Vegetarian, Vegan, and Portfolio)

Plant-based diets encompass dietary patterns that prioritize foods of plant origin while limiting animal products to varying degrees. The Portfolio diet, specifically, prioritizes nuts, plant proteins, soluble fiber, plant sterols, and sources of healthy fats. The high fiber and low saturated fat content of these patterns exert positive effects on body weight, insulin sensitivity, and glycemic control (Frigo et al., 2026).

Evidence supports the glycemic and cardiometabolic benefits of vegetarian and vegan diets in the context of type 2 diabetes. Meta-analyses report that these diets reduce HbA1c by an average of 0.36%, LDL cholesterol by 0.16 mmol/L, and body mass index by 0.94 kg/m² (Guest et al., 2024). Healthy plant-based dietary patterns have been shown to be associated with a reduced risk of type 2 diabetes, whereas patterns based on processed and refined plant products are linked to an increased risk (Murciano et al., 2025). High adherence to the Portfolio diet is also reported to be associated with lower levels of HbA1c, LDL, and non-HDL cholesterol, as well as a reduced risk of type 2 diabetes (Glenn et al., 2023; Kavanagh et al., 2024).

Evidence regarding plant-based diets is primarily derived from studies on type 2 diabetes, demonstrating that these diets support glycemic control, body weight management, and the management of cardiometabolic risk

(Guest et al., 2024). Regarding Type 1 diabetes, although evidence is limited, it is noted that this approach is feasible with appropriate planning and carbohydrate counting. Carbohydrate intake and insulin dosages must be adjusted according to individual requirements.

Plant-based diets are among the most environmentally sustainable dietary patterns due to their low greenhouse gas emissions and reduced land and water use. Vegan diets, in particular, are reported to stand out for their low carbon footprint (O'Malley et al., 2023). The Portfolio diet also supports this advantage through a composition based on plant proteins, nuts, and vegetable oils. Thus, plant-based diets combine health benefits with environmental sustainability in the context of diabetes management.

When properly planned, plant-based diets are considered safe and nutritionally adequate. Vegan diets, in particular, require vitamin B_{12} supplementation, and it is important to monitor the adequacy of iron, zinc, calcium, vitamin D, omega-3 fatty acids, and protein (Kraselnik & López-Moreno, 2026). However, high consumption of processed and refined plant-based products diminishes the expected health benefits (Murciano et al., 2025). Therefore, prioritizing whole and minimally processed plant-based foods and planning the diet according to individual needs is recommended.

High-Protein and Moderate-Carbohydrate Approaches

In high-protein diets, protein typically accounts for 25–30% of total energy intake, whereas in moderate-carbohydrate diets, carbohydrate intake is maintained at approximately 40–45%. These approaches enhance satiety, support the preservation of lean body mass and weight management, and limit postprandial glycemic fluctuations by reducing the carbohydrate load (Anjom-Shoae et al., 2024).

Although the effects of high-protein diets on HbA1c and fasting glucose are limited, they have been reported to improve levels of HOMA-IR, LDL cholesterol, total cholesterol, and triglycerides (Yu et al., 2020). Moderate-carbohydrate diets, meanwhile, have been shown to be effective in reducing fasting glucose and yielding positive outcomes regarding glycemic control (Jing et al., 2023). It is noted that these effects are largely associated with reductions in body weight (Jing et al., 2023).

For type 2 diabetes, high-protein and moderate-carbohydrate diets are considered viable options, particularly for supporting weight management and cardiometabolic health (Clina et al., 2023). In type 1 diabetes, however, high protein intake can lead to a delayed postprandial rise in glucose therefore, insulin dosages must be adjusted to account for the protein content of the meal. Nevertheless, it is reported that direct evidence regarding these diets in type 1 diabetes is limited.

The environmental impact of high-protein diets varies depending on the protein source. While dietary patterns dominated by animal protein are associated with higher greenhouse gas emissions and increased water and land use, opting for plant-based protein sources—such as legumes, soy, and nuts—reduces environmental impact (Drewnowski & Conrad, 2024). Therefore, prioritizing plant-based protein sources is recommended for both cardiometabolic health and sustainability.

Kidney function must be taken into account in high-protein diets. For individuals with diabetic kidney disease, it is recommended to avoid high protein intake and to maintain protein consumption at approximately 0.8 g/kg/day (ADA, 2026). Additionally, it is advised to choose plant-based proteins, fish, and lean protein sources over processed red meat. These approaches should be personalized based on individual requirements and kidney function.

Intermittent Fasting and Time-Restricted Eating

Intermittent fasting encompasses various dietary approaches in which periods of eating and fasting are organized into specific time intervals. In time-restricted eating, food intake is generally limited to an 8–10 hour window each day. The metabolic effects of this approach are primarily attributed to reduced energy intake and body weight, improved insulin sensitivity, and the alignment of meal timing with circadian rhythms (Msane et al., 2024).

Intermittent fasting has been reported to have positive effects on glycemic control in type 2 diabetes. Meta-analyses indicate an improvement in glycemic control-showing a standardized mean difference of 0.84-with the most pronounced effects observed in time-restricted eating (Anasanti & Hamzah, 2025). This approach has been reported to reduce fasting glucose by 0.74 mmol/L and HbA1c by 0.11%, while increasing the time spent within the target range by approximately 10.5 percentage points (Nam et al., 2025). However, it is noted that these effects are largely associated with energy restriction and weight loss, and that the approach does not demonstrate a significant superiority over continuous energy restriction (Sharma et al., 2023).

Intermittent fasting is considered a viable option for managing type 2 diabetes, particularly for supporting weight management and glycemic control. For individuals using insulin or insulin secretagogues, dose adjustments and close glucose monitoring are required to mitigate the risk of hypoglycemia (Al Qudah et al., 2026). In the case of Type 1 diabetes, it is not routinely recommended due to the risks of hypoglycemia, hyperglycemia, and diabetic ketoacidosis (Safari et al., 2025). For individuals who choose to fast, risk assessment, individualization of insulin dosage, and intensive glucose monitoring are recommended (Ibrahim et al., 2025).

The environmental impact of intermittent fasting largely depends on the quality of foods chosen during the eating window. While reducing energy intake and overconsumption has the potential to lower environmental burden and food waste, direct evidence on this matter remains limited. Implementing the practice with a focus on plant-based and minimally processed foods is considered more advantageous in terms of sustainability.

In intermittent fasting, the risk of hypoglycemia is a significant concern, particularly for individuals using insulin or insulin-secreting medications. In Type 1 diabetes, additional caution is required regarding ketoacidosis and dehydration. Its implementation is not considered appropriate during pregnancy or in cases of eating disorders, frailty in the elderly, and high-risk Type 1 diabetes (Ibrahim et al., 2025). Variations between studies and the inconsistency of long-term adherence limit the available evidence. Therefore, it is recommended that intermittent fasting be implemented in an individualized manner-particularly for Type 2 diabetes-accompanied by appropriate patient selection, medication adjustment, and medical monitoring.

Very-Low-Energy Diets and Type 2 Diabetes Remission

Very-low-energy diets involve structured programs that typically provide ≤800 kcal/day and are implemented for approximately 8–20 weeks (Churuangsuk et al., 2022). Significant energy restriction and body weight loss promote improvements in beta-cell function and remission in type 2 diabetes by reducing liver and pancreatic fat (Pescari et al., 2026). Remission is defined as maintaining an HbA1c level of <6.5% (48 mmol/mol) for at least three months after the discontinuation of glucose-lowering medications (Riddle et al., 2021).

Strong evidence supports the efficacy of very-low-energy diets in achieving remission in type 2 diabetes. In the DiRECT trial, a program providing 825–853 kcal/day resulted in remission rates of 46% at 12 months and 36% at two years (Lean et al., 2018; Lean et al., 2019). It has been shown that 81% of individuals who maintained a weight loss of ≥10 kg over two years remained in remission (Lean et al., 2024). Meta-analyses indicate that total diet replacement can achieve remission rates of up to 61% in the first year, with success primarily linked to the weight loss achieved and maintained (Churuangsuk et al., 2022).

Very-low-energy diets are implemented to induce remission, particularly in individuals with type 2 diabetes who have a short duration of the disease and do not use insulin (Lean et al., 2018). In type 1 diabetes, however, remission is not achieved due to beta-cell loss, and severe energy restriction increases the risk of hypoglycemia and ketoacidosis (Lean et al., 2024). Therefore, it is not recommended as a treatment for type 1 diabetes. Very-low-energy diets are implemented as a short-term therapeutic approach rather than a long-term dietary pattern. Long-term sustainability depends on the dietary pattern adopted after the program and the maintenance of body weight. Transitioning to a plant-based dietary pattern is considered to potentially support environmental sustainability (O'Malley et al., 2023).

Very-low-energy diets must be administered under medical supervision, with adjustments made to antidiabetic and antihypertensive medications as necessary (Brown et al., 2020). Side effects such as constipation, gallstones, and other transient complaints may occur. Since weight regain is associated with the loss of remission, long-term weight management is crucial (Lean et al., 2024). Their use is not recommended in cases such as type 1 diabetes, pregnancy, or a history of eating disorders.

Limitations of Studies on Dietary Models

A significant proportion of studies comparing dietary models are short-term, and long-term, direct comparisons are limited. This situation complicates inferences regarding the durability of differences between the models. There is marked heterogeneity across studies concerning the definition and intensity of interventions and the methods used to measure adherence, which makes interpreting effect sizes difficult (Jing et al., 2023). Furthermore, the fact that glycemic improvement occurs largely through weight loss makes it challenging to isolate effects specific to a particular dietary model from those resulting from weight change (Churuangsuk et al., 2022). The depth of the evidence base is also uneven across different models and diabetes types while data regarding type 2 diabetes are relatively abundant, direct evidence for type 1 diabetes remains limited for most models. Finally, variability in the definitions of outcome measures-such as remission-and in the conditions surrounding the maintenance of adherence limits the comparability of studies. These limitations necessitate a cautious interpretation of findings and the implementation of recommendations tailored to the individual.

Conclusions and Recommendations

There is no single ideal dietary model for the medical nutrition therapy of type 1 and type 2 diabetes; the nutritional approach must be tailored to the individual's metabolic goals, treatment regimen, preferences, and lifestyle circumstances. While glycemic control, weight management, and-in suitable individuals-remission are prioritized in type 2 diabetes, carbohydrate counting, matching insulin doses to food intake, and safety are key considerations in type 1 diabetes. Long-term success depends more on the individual's adherence to the diet and its sustainability than on the specific type of dietary model chosen.

Mediterranean, low-glycemic-index, and plant-based dietary models stand out not only for their clinical benefits but also for their low environmental impact. Therefore, nutritional therapy takes into account cultural and economic conditions, food accessibility, and environmental sustainability alongside health goals. In conclusion, it is recommended that evidence-based dietary models for diabetes management be individualized and maintained through long-term professional support.

Scientific Ethics Declaration

* The author declares that the scientific ethical and legal responsibility of this article published in EPHELS journal belongs to the author.

Conflict of Interest

* The author declares that there is no conflict of interest

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