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The effects of nutrition on type 2 diabetes risk and management: A systematic review of studies published between 2015 and 2025

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Abstract

Background/Aim: Type 2 diabetes is a major global metabolic disorder, and nutritional exposure is central to both prevention and long-term glycemic management. This systematic review evaluated the effects of dietary patterns, macronutrient composition, fiber intake, protein source, and lifestyle-based nutritional interventions on type 2 diabetes risk and management.

Methods: A literature search was performed in Google Scholar, Web of Science, PubMed, Scopus, and the Cochrane Library on August 27, 2025. The search used combinations of type 2 diabetes, nutrition, diet, dietary patterns, glycemic control, prevention, and management. English-language studies published between 2015 and 2025 were screened. Randomized trials, cohort studies, systematic reviews, and meta-analyses were considered eligible. Studies not directly related to type 2 diabetes or nutrition were excluded. Eligible evidence was synthesized narratively.

Results: A total of 1,200 records were initially identified, and 40 studies were included after screening and eligibility assessment. Mediterranean, plant-based, and fiber-rich dietary patterns were consistently associated with improved glycemic control, lower cardiometabolic risk, and reduced type 2 diabetes risk. Low-carbohydrate diets showed short-term benefits for hemoglobin A1c and body weight, although long-term sustainability and safety remained uncertain. Protein quality, particularly the balance between plant and animal protein sources, also appeared relevant to insulin resistance and metabolic outcomes. Lifestyle-based and digital interventions enhanced adherence but showed variable durability.

Conclusion: Nutrition is a cornerstone of type 2 diabetes prevention and management. Current evidence favors individualized, sustainable dietary strategies emphasizing overall diet quality, fiber-rich foods, plant-forward patterns, and integration with behavioral support rather than reliance on a single universal diet model.

Keywords: type 2 diabetes, nutrition, dietary patterns, glycemic control, prevention

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Ethics Committee Approval
Ethics committee approval was not required because this review did not involve human participants, animal experiments, patient-level data, or identifiable personal information. Informed consent was not applicable.

Conflict of Interest
No conflict of interest was declared by the authors.

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Introduction

Type 2 diabetes (T2D) is one of the most important metabolic and public health challenges worldwide. Recent global estimates show that the total diabetes burden has increased substantially, and projections indicate that the number of people living with diabetes will continue to rise over the coming decades, with T2D accounting for most cases [1, 2]. This increasing burden is driven by population aging, urbanization, excess adiposity, sedentary behavior, and dietary patterns characterized by high energy density and low nutritional quality [3, 4].

Nutrition has a direct role in glucose homeostasis, insulin sensitivity, body weight regulation, lipid metabolism, and systemic inflammation. Dietary approaches such as Mediterranean, plant-based, high-fiber, low-glycemic-index, and carbohydrate-modified diets have been investigated for both prevention and management of T2D [5-8]. However, the comparative interpretation of these approaches remains difficult because studies differ in design, intervention intensity, follow-up duration, baseline metabolic risk, and adherence support.

Beyond individual macronutrients, contemporary diabetes nutrition science increasingly emphasizes dietary patterns, food quality, behavioral adherence, cultural suitability, and long-term sustainability. Therefore, a broad synthesis of current evidence is useful for clinicians, dietitians, and researchers. This systematic review aimed to summarize evidence published between 2015 and 2025 regarding the effects of nutrition on T2D risk and management.

Materials and methods

Study design

This review was designed as a systematic literature review with narrative synthesis. The reporting structure was refined to improve transparency and consistency with common biomedical reporting principles. Because of heterogeneity in study design, population characteristics, dietary interventions, and outcomes, no quantitative meta-analysis was performed.

Search strategy

A literature search was performed in Google Scholar, Web of Science, PubMed, Scopus, and the Cochrane Library on August 27, 2025. Search terms included combinations of type 2 diabetes, nutrition, diet, dietary patterns, dietary intervention, glycemic control, prevention, management, hemoglobin A1c, insulin resistance, Mediterranean diet, plant-based diet, low-carbohydrate diet, fiber, and protein. The search was limited to studies published in English between January 1, 2015, and August 27, 2025.

Inclusion and exclusion criteria

Randomized controlled trials, prospective cohort studies, systematic reviews, and meta-analyses evaluating the relationship between nutrition and T2D prevention or management were included. Eligible studies reported outcomes related to incident T2D, hemoglobin A1c, fasting plasma glucose, insulin resistance, body weight, cardiometabolic risk factors, adherence, or diabetes-related lifestyle management. Studies were excluded if they were not directly related to T2D, did not evaluate a nutritional exposure or intervention, were not available in English, were animal or laboratory-only studies, or were published outside the defined time window unless they were used as foundational background evidence.

Study selection and risk of bias assessment

Records were screened by title and abstract, followed by full-text evaluation for potentially eligible studies. Studies were grouped thematically according to dietary patterns, carbohydrate modification, fiber and whole grains, protein source and amino acid profile, and lifestyle or digital nutritional support. The submitted manuscript stated that risk of bias was evaluated using the Cochrane risk-of-bias approach for randomized trials and the Newcastle-Ottawa Scale for observational studies; however, individual domain-level ratings were not provided in the submitted file.

Statistical analysis

A descriptive narrative synthesis was performed. No pooled effect estimates, hypothesis tests, or new inferential statistics were calculated. Therefore, P-values were not applicable to the review synthesis.

Ethical considerations

This review was based exclusively on previously published literature and did not involve human participants, animal experiments, patient-level data, or identifiable information. Therefore, ethics committee approval and informed consent were not required.

Results

Study selection

The search identified 1,200 records. After removal of duplicates and title-and-abstract screening, 150 full-text reports were assessed for eligibility. Forty studies met the inclusion criteria and were included in the final synthesis. The study selection process is shown in Figure 1.

Figure 1. PRISMA 2020 flow diagram of the study selection process (initial records identified: 1200; studies included: 40).

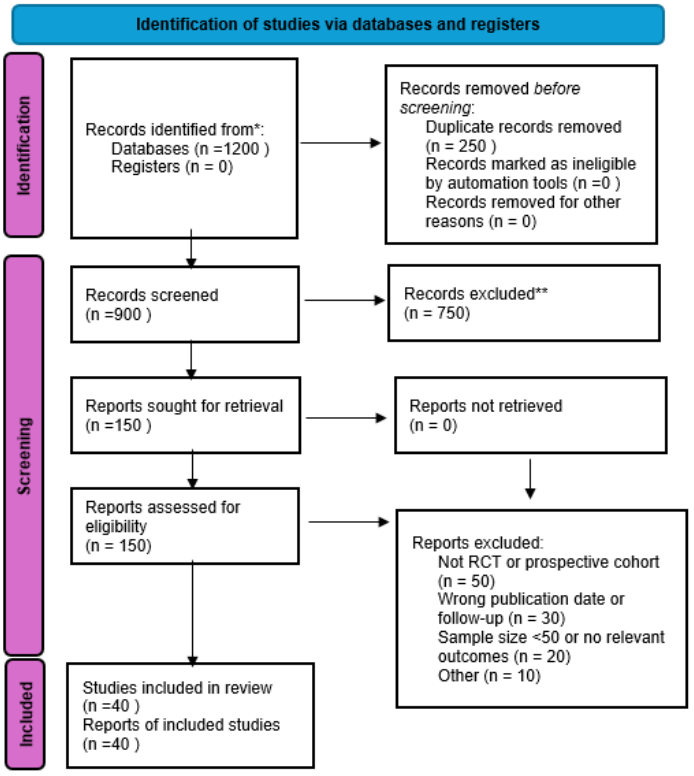

Table 1. Summary of principal findings by nutritional domain.

Nutritional domain	Evidence base and outcomes	Principal findings and clinical interpretation	References
Dietary patterns	12 studies; T2D risk, HbA1c, body weight, and cardiometabolic markers.	Mediterranean, plant-based, and overall high-quality dietary patterns were generally associated with better glycemic and cardiometabolic profiles. This was the most consistent and clinically applicable evidence domain; adherence and food quality remain central.	[5-15]
Low-carbohydrate and macronutrient composition	8 studies; HbA1c, body weight, lipids, and remission-related outcomes.	Low-carbohydrate approaches showed short-term metabolic benefits, but long-term superiority was less consistent. They may be useful for selected patients when medication adjustment and clinical monitoring are available.	[7, 16-22]
High-fiber and whole-grain intake	6 studies; T2D incidence, postprandial glucose, and weight control.	Higher fiber and whole-grain intake were associated with lower T2D risk and improved metabolic responses. These data support recommending minimally processed, fiber-rich carbohydrate sources rather than broad carbohydrate avoidance.	[23-27]
Protein source and amino acid profile	5 studies; insulin resistance and metabolic risk.	Plant-forward protein patterns appeared more favorable than animal-heavy patterns in observational evidence; branched-chain amino acid signatures were linked to insulin resistance. Protein recommendations should consider kidney function, sarcopenia risk, weight goals, and cardiometabolic risk.	[28, 29]
Lifestyle-based and digital nutritional support	9 studies; adherence, body weight, HbA1c, and prevention outcomes.	Structured lifestyle programs and digital support tools improved adherence and self-management, although durability varied. These interventions appear most effective when integrated with behavioral counseling and ongoing follow-up.	[30-33]

HbA1c: hemoglobin A1c, T2D: type 2 diabetes.

Principal findings

The included evidence indicated that overall dietary pattern quality was more clinically relevant than any isolated nutrient. Mediterranean and plant-forward diets were associated with improved glycemic control, weight-related outcomes, and cardiometabolic risk profiles. Low-carbohydrate diets were associated with short-term improvements in hemoglobin A1c and body weight, but their long-term advantage over balanced dietary approaches was less consistent. High-fiber and whole-grain patterns were associated with lower T2D risk and improved postprandial metabolic responses. Protein source also appeared important, with plant-forward dietary patterns showing more favorable associations with insulin resistance than animal-heavy dietary patterns. Lifestyle-based programs and digital interventions improved adherence and self-management when supported by structured follow-up. The principal findings are summarized in Table 1.

Discussion

This systematic review supports the central role of nutrition in both prevention and management of T2D. The most consistent message across the included literature is that sustainable dietary patterns emphasizing whole foods, fiber-rich carbohydrates, unsaturated fats, and plant-forward choices are more clinically useful than rigid single-nutrient prescriptions. This interpretation is consistent with contemporary diabetes nutrition guidance, which emphasizes individualization, metabolic goals, patient preferences, comorbidities, and long-term adherence [8].

Mediterranean and plant-forward dietary patterns showed the most coherent benefits across glycemic and cardiometabolic outcomes. These patterns combine several favorable characteristics, including high intake of vegetables, legumes, whole grains, nuts, olive oil or other unsaturated fat sources, and relatively low intake of refined carbohydrates and ultra-processed foods. Their benefits are likely mediated through multiple mechanisms, including improved insulin sensitivity, reduced adiposity, lower systemic inflammation, and improved lipid profiles.

Low-carbohydrate dietary approaches may be useful for selected patients, particularly in the short term and when medication adjustment and clinical monitoring are available. However, long-term adherence, nutritional adequacy, lipid response, renal considerations, and patient acceptability should be considered before recommending highly restrictive approaches. The evidence does not support a single universal diet for all patients with T2D. Instead, it supports individualized dietary planning that prioritizes safety, feasibility, cultural acceptability, and durability.

Fiber and whole grains represent another important component of diabetes prevention and management. Higher intake of dietary fiber and whole-grain foods may improve satiety, reduce postprandial glycemic excursions, enhance gut microbiota-related metabolic pathways, and support weight control. These findings argue against broadly discouraging all carbohydrate sources and instead support differentiating high-quality, minimally processed carbohydrates from refined starches and added sugars.

Protein source and overall dietary context also deserve attention. Evidence linking branched-chain amino acid profiles, insulin resistance, and animal-heavy dietary patterns suggests that protein quality may influence metabolic risk. Nevertheless, protein recommendations should be individualized according to kidney function, age, sarcopenia risk, weight goals, and comorbid disease burden.

This review has limitations. The included studies were heterogeneous in design, follow-up duration, dietary definitions, adherence assessment, and outcome reporting. Some dietary categories overlapped, and several interventions combined diet with physical activity, behavioral support, or digital tools, limiting attribution of effects to diet alone. The submitted manuscript also did not provide detailed study-level risk-of-bias ratings, which limits the ability to judge the certainty of evidence across categories.

Despite these limitations, the overall evidence is clinically practical. Nutritional care for T2D should not be framed as a short-term diet prescription but as a long-term therapeutic strategy integrated with weight management, medication review, behavioral counseling, and cardiometabolic risk reduction.

Conclusion

Nutrition plays a decisive role in T2D prevention and management. The current evidence favors individualized, sustainable, high-quality dietary patterns rather than a single rigid diet model. Mediterranean, plant-forward, fiber-rich, and minimally processed dietary patterns appear most consistently beneficial, while carbohydrate-restricted approaches may be useful in selected patients with appropriate clinical monitoring. Future research should focus on long-term adherence, implementation in routine care, cultural adaptation, and patient-centered outcomes.

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