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Consensus

Expert consensus on medical nutrition therapy for people with type 2 diabetes

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Abstract

Context: Medical nutritional therapy is a cornerstone intervention for managing type 2 diabetes. However, despite existing clinical guidelines, robust evidence to support recommendations on many topics remains limited.

Objective: The objective of this work is to develop an expert consensus that provides clinically relevant guidance by integrating professional expertise with a systematic interpretation of the available evidence. This approach aims to ensure that decisions are informed, balanced, and grounded in the best possible understanding of current research and practical experience.

Methods: This consensus process followed a structured three-step approach. First, a focus group was conducted to identify key topics requiring attention. Next, PICO model questions were formulated, and evidence was systematically reviewed to address them. Finally, the Nominal Group Technique was applied to achieve consensus among the panel members. A combination of quantitative and qualitative analysis was used to formulate the final consensus statements.

Results: Six main topics related to medical nutritional therapy in type 2 diabetes were rigorously analyzed and discussed. A systematic review of 247 peer-reviewed articles supported the expertise of the multidisciplinary panel. The panel generated 127 ideas across the 6 topics, achieving consensus on 78 of them. These consensus statements provide clear definitions and practical recommendations for implementing medical nutritional therapy in clinical practice.

Highlights

- Medical nutritional therapy is crucial for managing type 2 diabetes; this consensus provides practical, evidence-based action points.
- A structured process led to a consensus on 78 out of 127 ideas, supported by a review of 247 articles.
- The consensus could improve type 2 diabetes treatment in Colombia, focusing on an often underrated nutritional therapy.

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Conclusions: This consensus represents the first step forward in addressing a common yet often overlooked aspect of type 2 diabetes treatment in Colombia: medical nutritional therapy. By integrating multidisciplinary expertise and evidence-based analysis, it delivers actionable and clinically meaningful recommendations to improve patient care.

Keywords: Diabetes mellitus, Nutrition, Medical nutrition therapy, Dietary supplements, Dietary patterns, Consensus.

Consenso de expertos sobre terapia médica nutricional para personas con diabetes tipo 2

Resumen

Contexto: la terapia médica nutricional (TMN) es una intervención fundamental para el manejo de la diabetes tipo 2. Sin embargo, a pesar de las guías clínicas existentes, la evidencia sólida que respalde las recomendaciones en muchos temas sigue siendo limitada.

Objetivo: el objetivo de este trabajo es desarrollar un consenso de expertos que proporcione orientación clínicamente relevante mediante la integración de la experiencia profesional con una interpretación sistemática de la evidencia disponible. Este enfoque busca garantizar que las decisiones sean informadas, equilibradas y fundamentadas en la mejor comprensión posible de la investigación actual y la experiencia práctica.

Métodos: el proceso de consenso siguió un enfoque estructurado en tres etapas. Primero, se llevó a cabo un grupo focal para identificar los temas clave que requieren atención. Luego, se formularon preguntas utilizando el modelo PICO y se revisó sistemáticamente la evidencia para abordarlas. Finalmente, se aplicó la Técnica de Grupo Nominal para lograr consenso entre los miembros del panel. Se utilizó un análisis combinado cuantitativo y cualitativo para formular las declaraciones finales de consenso.

Resultados: se analizaron y discutieron rigurosamente seis temas principales relacionados con la terapia médica nutricional en la diabetes tipo 2. Una revisión sistemática de 247 artículos revisados por pares respaldó la experiencia del panel multidisciplinario. El panel generó 127 ideas sobre los seis temas, logrando consenso en 78 de ellas. Estas declaraciones de consenso ofrecen definiciones claras y recomendaciones prácticas para implementar la terapia médica nutricional en la práctica clínica.

Conclusiones: este consenso representa un primer paso significativo para abordar un aspecto común pero a menudo pasado por alto del tratamiento de la diabetes tipo 2 en Colombia: la terapia médica nutricional. Al integrar la experiencia multidisciplinaria y el análisis basado en evidencia, se ofrecen recomendaciones accionables y clínicamente significativas para mejorar la atención al paciente.

Palabras clave: diabetes mellitus, nutrición, terapia médica nutricional, suplementos dietéticos, patrones dietéticos, consenso.

Destacados

- La terapia médica nutricional es crucial para manejar la diabetes tipo 2, este consenso provee recomendaciones basadas en la evidencia.
- Un proceso estructurado logró un consenso en 78 de 127 ideas, respaldado por una revisión de 247 artículos.
- Este consenso podría ayudar a mejorar el tratamiento de la diabetes tipo 2 en Colombia, enfocándose en una terapia nutricional, a menudo subestimada.

Introduction

Type 2 diabetes (T2D) is one of the most prevalent chronic noncommunicable diseases worldwide, and Colombia ranks second only to Brazil in South America for the highest prevalence of the disease (1). This can be attributed to various factors, including demographic and nutritional transitions, internal migration due to urban development and violence, and increasingly

sedentary lifestyles (2). In recent decades, the accelerated migration from rural to urban areas in Colombia may have significantly influenced the progression of lifestyle-related conditions such as type 2 diabetes. The estimated prevalence of T2D in Colombia's rural areas ranges from 1% to 2%, increasing to 7%-11% in urban areas (3, 4). Colombia's rich ethnic diversity, resulting from the intermingling of Indigenous Amerindians, Spanish settlers, and enslaved Africans, further influences the risk factors for developing T2D. This complex ancestry has been shown to play a role as a factor associated with an increased risk of developing T2D (5).

Nutrition plays a critical role in both the prevention and treatment of T2D. Medical nutrition therapy (MNT) for individuals with T2D has been shown to improve control of glycated hemoglobin (HbA1c) with reductions of up to 2.0%, as well as reductions in blood pressure, low-density lipoprotein cholesterol (LDL-C), and body weight (6, 7). However, MNT is not a 'one-size-fits-all' intervention. The delivery of evidence-based nutrition care encompasses a range of activities, including education on healthy eating behaviors and nutritional plans tailored to optimize metabolic control. These interventions are designed to reduce the risk of diabetes-related complications, achieve and maintain body weight goals, and alleviate the burden of common comorbidities such as high blood pressure and dyslipidemia.

The proper implementation of MNT, however, faces several challenges. First, the generation of high-quality evidence for nutritional interventions is inherently difficult. Most of the scientific evidence on nutritional habits or interventions and metabolic outcomes arises from observational research, making it challenging to translate findings into clinical practice (8, 9). General nutritional recommendations must be adapted to accommodate regional and local customs and lifestyles, culinary particularities, economic considerations, and local food availability. However, widespread confusion surrounding dietary guidelines—amplified by conflicting messages on social media—adds to the challenge. This misinformation complicates adherence to healthy eating practices for both patients and healthcare providers, making clear, evidence-based guidance all the more essential.

Structured consensus techniques, particularly when evidence is limited, play a critical role in generating clinical practice recommendations (10). A multidisciplinary panel comprising registered nutritionists, endocrinologists, and metabolism experts was convened. The process began with a focus group to identify key topics of interest related to MNT for individuals with type 2 diabetes. Next, research questions were formulated using the PICO model, and a systematic literature review was conducted to provide the panel with evidence-based insights. Through qualitative analysis, the primary topics of interest were identified. The panel then employed the Nominal Group Technique to reach consensus on definitions and recommendations for MNT for people with T2D.

Methods

Systematic review

A systematic review (SR) of the literature was conducted to inform the consensus. The protocol for this SR was not registered. The SR followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology (11). The studies included were clinical practice guidelines (CPG), systematic reviews (SR), randomized controlled clinical trials (RCT), and observational studies (OS) comparing any form of nutritional therapy with standard of care, education, or any other form of dietary advice.

The study included only research focused on adult patients with type 2 diabetes mellitus, as defined by the standards of the American Diabetes Association (ADA). Ideally, these studies detailed both the diagnostic criteria used and the duration since diagnosis. Eligible studies evaluated at least one of the following outcomes: glycemic control (e.g., changes in blood glucose levels, HbA1c, or CGM-derived metrics), anthropometric measures (e.g., changes in body weight, BMI, or waist circumference), blood pressure, or plasma lipid levels.

A comprehensive search was conducted across multiple databases, including MEDLINE (via PubMed), Embase, the Cochrane Central Register of Controlled Trials (CENTRAL), and LILACS (Virtual Health Library), covering the period from 2014 to October 2024.

The search results were included in the web application Rayyan (https://www.rayyan.ai/) (12), and duplicate publications were removed using this application's automatic aiding tool. Data extraction was carried out by two researchers, who independently reviewed the titles and abstracts of all records retrieved during the search to identify studies for inclusion. Full-text reviews were conducted for all articles deemed potentially relevant. Any disagreements were addressed by a third researcher, with resolutions documented and discussed during a group meeting. Following the PRISMA statement (11), the selection process is shown in Figure 1. Studies were selected based on the following criteria: The study was a Clinical Practice Guideline (CPG), Systematic Review (SR), Randomized Controlled Trial (RCT), or Observational Trial (OT). The target population included adult patients with type 2 diabetes. The study intervention or comparator involved any form of nutritional therapy. Outcome measures of interest to the review were recorded as part of the study CPG or SR.

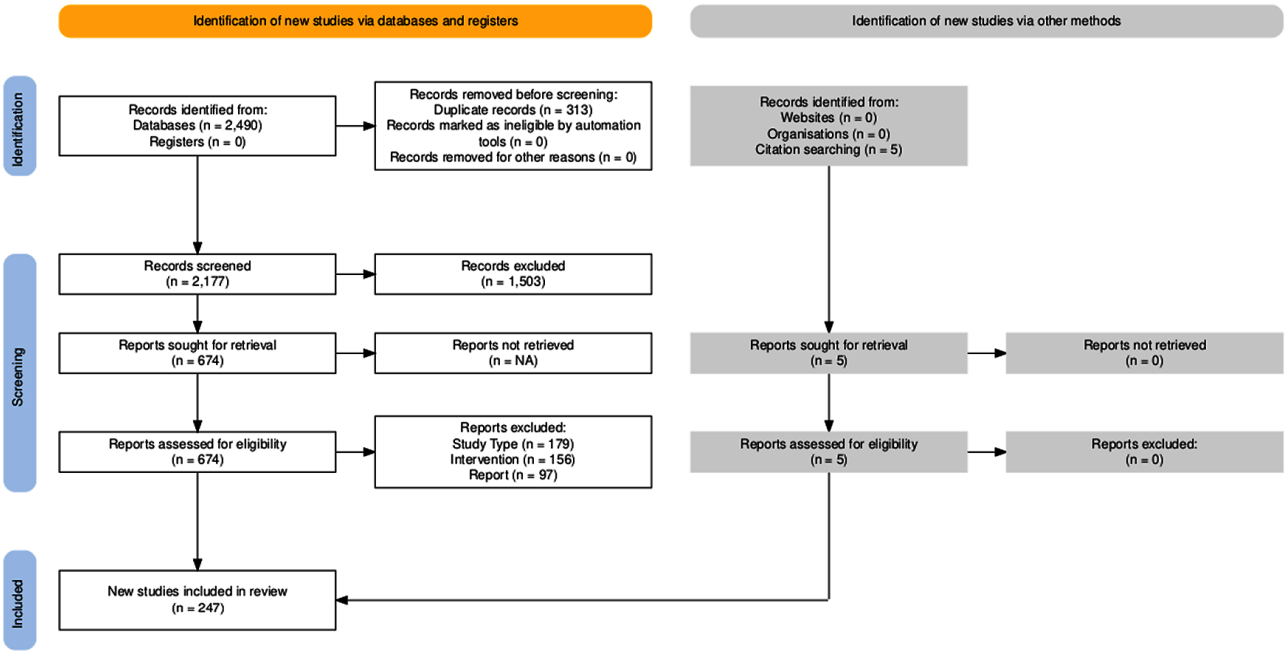

Figure 1. PRISMA Flow Diagram
Source: Own elaboration

Only data from studies with a low or uncertain risk of bias were employed, numbers were extracted as provided by the authors in the selected studies. Data were compiled in a spreadsheet containing the following fields: consecutive number, name of the researcher responsible for data extraction, date of extraction, study title, author/year, journal, country, study design, study period, objective, population characteristics (age group, diagnoses) and number of participants (total and by group), intervention details (dose, frequency, duration of treatment), comparator details (dose, frequency, duration of therapy), outcomes (measurement method, follow-up time), results/findings (provided for each outcome) including narrative

description, association estimates, confidence intervals or p-values, conclusion, and risk of bias.

Risk of bias (ROB) was assessed by two researchers. For SR, it was evaluated using the Risk of Bias for Systematic Reviews (ROBIS) tool (13). RCTs were evaluated with the Cochrane Risk of Bias 2.0 tool (RoB 2.0) (14), while OS (cohort, case-control, or comparative cross-sectional studies), were assessed with the Risk Of Bias In Non-randomised Studies - of Interventions (ROBINS-I) tool (15). Disagreements were resolved in discussion with a third researcher.

Nominal Group Technique

Three authors (AMS, KRE, KPE) made up the project coordinating committee. A focus group was conducted iteratively to plan the questions and statements for discussion in the Nominal Group Technique (NGT). The expert panel consisted of seven experts (16): four endocrinologists, two registered nutritionists, and one medical doctor specializing in metabolic medicine. These experts were selected for their proficiency in treating individuals with type 2 diabetes, experience in nutritional therapy, research in metabolic medicine and nutrition, and involvement in formulating or implementing local guidelines within the healthcare system.

A modified NGT was used, retaining its main phases: (i) The Nominal or Silent Phase, where participants individually considered a question presented to them and wrote down their responses; (ii) The Item Generation Phase, where participants shared their responses with the group in turns, with items recorded without discussion; (iii) The Discussion and Clarification Phase, where group members discussed, clarified, and elaborated on the items, combining similar ones and removing duplicates; and (iv) The Voting Phase, where participants prioritized the items by assigning ranks to them (16, 17). The Nominal or Silent Phase was conducted using an online questionnaire. The Item Generation Phase and the Discussion and Clarification Phase were held online using a videoconference platform, and the meeting was transcribed using the artificial intelligence tool Read AI. Finally, the Voting Phase was carried out via an online form, utilizing a 9-point Likert scale for each idea.

During the NGT meeting, qualitative and quantitative data were collected and analyzed using thematic analysis to identify key themes. Since achieving consensus was the primary objective of the NGT, the data are presented primarily as thematic analysis results in the form of statements. Subsequently, a draft of the analysis was shared with participants, who agreed that the data accurately represented the discussions.

Consensus

The online questionnaire responses were exported to a spreadsheet for consensus analysis. A threshold level of agreement of 75% among participants was established across the following ranges: 1–3 points for "limited importance", 4–6 for "important but not critical", and 7–9 for "critically important". In instances of strong disagreement, characterized by one panel member scoring a 1 and another scoring a 9, outliers were excluded, and the remaining responses were reviewed for consensus. The median and interquartile range for each statement and all statements that achieved consensus were calculated to illustrate the variability around the consensus (18). Consensus statements were formulated using the categories identified through the qualitative content analysis of the ideas regarding which consensus was reached.

Results

The SR was utilized to inform the expert panel, and 247 relevant studies were identified (see Figure 1).

A qualitative thematic analysis of the ideas generated in the focus group revealed six main topics: Professional Training in Nutrition and T2D; Importance of Adhering to Medical Nutritional Therapy; Specific Nutritional Approaches to Achieve Target Objectives in Individuals with T2D; Impact of Chrono-Nutrition on T2D; Interaction Between Medical Nutritional Therapy and Pharmacological Treatment for T2D; and Safety and Use of Sweeteners and Supplements in Individuals with T2D. The Generation Phase of the Nominal Group Technique (NGT) yielded 127 ideas related to these subjects, which were subsequently narrowed down to 112 during the

Discussion and Clarification Phase. Ultimately, consensus was reached whereby 78 of these ideas were considered critically important, 28 were deemed necessary but not critical, and six were classified as having limited importance. The median overall score of ideas reaching consensus was eight (IRQ: 0.5).

Professional Training in Nutrition and T2D

In people with T2D, MNT delivered by a trained professional has a greater effect on HbA1c, weight, and LDL-C (5) compared to when it is provided by other healthcare staff. Furthermore, health professionals trained in medical nutrition therapy can integrate dietary management with other aspects of diabetes care (19).

In Colombia, there is a pressing need to enhance nutrition education for healthcare professionals (19). Current professional nutrition programs allocate minimal hours to specialized clinical nutrition training, leaving gaps in knowledge and limiting the integration of nutritional care into clinical practice (20). The consensus statements are presented on Table 1.

Table 1. Consensus statements on professional training in nutrition and T2D

Category	Statement
Fundamental knowledge	All healthcare professionals should understand nutrition concepts to ensure effective and consistent communication with patients.
Academic training	Nutritionists/dietitians are the most qualified healthcare professionals to deliver MNT. Other healthcare professionals should have an educational background in clinical nutrition or medicine, specializing in the nutritional management of diabetes.
Certification and specialization	Nutritionists/dietitians must be certified and have specific training in diabetes management, including carbohydrate counting in diabetes.
Training in technologies and communication skills	Professionals should be trained in continuous glucose monitoring technologies and its interpretation. They should also have the right communication skills to improve patient adherence to treatment through techniques such as motivational interviewing.

Source: Own elaboration

Importance of Adhering to Medical Nutritional Therapy

Regular follow-up in MNT for type 2 diabetes management is crucial and associated with HbA1c improvement (19). A clinical trial compared a 3-month visit frequency to a more intensive outpatient follow-up of once-a-month visits for 12 months in people with T2D on oral medications. The more intensive strategy significantly reduced fasting blood glucose,

2-hour postprandial blood glucose, and HbA1c (21). While many clinical guidelines advocate for a personalized approach to follow-up frequency for MNT, there is currently a lack of strong evidence to support an optimal frequency. See consensus statements on Table 2.

Table 2. Consensus statements on importance of adhering to medical nutritional therapy

Category	Statement
Initial nutritional evaluation	Conducting 3 to 6 evaluations during the initial 6 months is recommended.
Follow-up frequency	Follow-up appointments with healthcare professionals should occur ideally every 3 months, with ongoing reviews based on achieved goals. This is especially true for Colombia, where the limited availability of healthcare professionals and the geographic dispersion of patients make individualized follow-up difficult to sustain.
Comprehensive support	Providing additional support and access to support groups between appointments helps improve adherence and treatment management.
Consistent communication	Information from various healthcare professionals should be consistent to provide unified education.

Source: Own elaboration

Specific Nutritional Approaches to Achieve Target Objectives in Individuals with T2D

The panel identified three target objectives that could benefit from different nutritional approaches in people with T2D: glycemic control, weight loss, and frequent comorbidities such as high blood pressure and dyslipidemia.

Different dietary patterns, including Mediterranean, low-carbohydrate, and plant-based diets, have been shown to improve metabolic outcomes for patients with T2D (see Table 3). These nutritional approaches prioritize a reduction of carbohydrate consumption, especially those derived from high-glycemic index foods, while promoting the inclusion of low-glycemic index options to improve glycemic control. There is also much emphasis on the quality of fats in the diet, with recommendations to replace saturated and trans fats with monounsaturated and polyunsaturated fats, aiming to reduce cardiovascular risk and improve glucose metabolism.

Evidence suggests that several recently developed diets such as intermittent fasting (IF)—which includes cycles of eating and fasting, like alternate-day fasting or time-restricted eating—can lead to weight loss and may improve glycemic control, although its impact on HbA1c is not significantly different from other diets (22). Indeed, the American Diabetes Association has deemed intermittent fasting and time-restricted eating useful for people with diabetes who are looking for practical eating management tools due to their simplicity (23).

Another popular dietary approach is the paleo diet, which emphasizes whole foods, lean proteins, fruits, vegetables, nuts, and seeds while excluding processed foods, grains, and dairy. Despite its widespread adoption, high-quality evidence specifically assessing its impact on glycemic control in T2D remains limited. In contrast, the ketogenic diet, defined by its very low carbohydrate intake and high-fat content, has demonstrated potential benefits in reducing HbA1c and fasting glucose levels in T2D patients. Nonetheless, significant concerns persist about its long-term safety and sustainability, necessitating further research to validate its efficacy and applicability in broader clinical contexts (24).

Another evidence-based dietary pattern is the DASH diet, originally designed to lower blood pressure. It emphasizes a high intake of fruits, vegetables, whole grains, and low-fat dairy, with a reduced consumption of saturated fat and sugar. The DASH diet has been shown to reduce glycemia, blood pressure, lipid levels, and insulin requirements in individuals with T2D (25). Importantly, the DASH diet does not induce significant weight loss and should not be used with this aim.

The consensus statements on this topic are presented on Table 4.

Table 3. Main dietary patterns and their definitions

Dietary pattern	Definition
Mediterranean diet	This diet focuses on using olive oil as the primary fat source, along with a high intake of fish, seafood, vegetables, nuts, fruits, beans, and whole grains. It includes moderate consumption of dairy products and occasional red meat, with wine in moderation and limited sweets.
Low-fat diet	This diet emphasizes the consumption of vegetables, fruits, starchy foods (such as bread, pasta, whole grains, and starchy vegetables), lean protein sources, and low-fat dairy products. It is characterized by a total fat intake of 30% or less of total calories, with saturated fat intake limited to 10% or less.
Low-carbohydrate diet	This diet involves reducing carbohydrate intake to 26% to 45% of total calories. It emphasizes low-carbohydrate vegetables, meats, poultry, fish, shellfish, eggs, cheese, nuts, oils, butter, and avocado while avoiding high-starch and high-sugar foods.
Very low-carbohydrate diet	This is a stricter version of the low-carbohydrate diet, limiting non-fiber carbohydrates to 20 to 50 grams per day to induce ketosis, with more than 50% of calories coming from fat.
Vegetarian/vegan diets	Vegetarian diets exclude all types of meat but may include eggs (ovo) and/or dairy (lacto) products. In contrast, vegan diets eliminate all animal-derived products. Individuals following these diets may need to supplement certain vitamins and minerals due to the absence of animal products.

Dietary approaches to stop hypertension (DASH)	This diet restricts sodium while promoting sufficient potassium intake, whole grains, vegetables, fruits, low-fat dairy, poultry, and fish, and it limits saturated fats, red meat, sweets, and sugary drinks.
Intermittent fasting	Intermittent fasting is a dietary strategy that involves alternating periods of eating and fasting. The main forms include: Alternate-day fasting: This regimen involves alternating between days of normal eating and days where calorie intake is significantly reduced, typically to about 500-600 calories. 5:2 diet: In this pattern, individuals eat normally for five days of the week and restrict calorie intake to 500-600 calories on two non-consecutive days. Time-restricted eating: It involves consuming all daily calories within a specific time window, usually ranging from 4 to 10 hours, and fasting for the remaining hours of the day. This approach can be adapted to any eating pattern.
Paleo diet	This diet emphasizes whole foods that are presumed to have been available to humans during the Paleolithic era, such as lean meats, fish, fruits, vegetables, nuts, and seeds, while excluding processed foods, grains, legumes, and dairy.
Ketogenic diet	This diet is characterized by a very low carbohydrate intake (20 to 50 grams per day) to induce ketosis, resulting in a high fat intake of more than 50% of total calories. It shares similarities with other very low-carbohydrate diets.

Source: Own elaboration

Table 4. Consensus statements on specific nutritional approaches to achieve target objectives in individuals with T2D

Category	Statement
Carbohydrates	Managing carbohydrate intake by prioritizing low-glycemic index foods and reducing simple carbohydrates is essential for adequate glycemic control. Carbohydrates with low glycemic indices also aid in triglyceride reduction.
Fiber	A balanced diet rich in fiber (30 to 50 grams daily), with a significant portion of this fiber being soluble, is crucial for overall health and glycemic management.

Healthy fats	Healthy fats—monounsaturated and polyunsaturated fats from sources like fish, nuts, and oils in particular—are recommended for cardiovascular health and metabolic benefits. For optimal cardiovascular health, diets should prioritize unsaturated fats, rich in omega-6 and omega-3, with limited saturated fat and no trans fats.
Personalized interventions	Personalized dietary interventions are essential for effective diabetes management and should consider factors such as age, type of diabetes, daily activity, and social determinants of health.
Portion control education	Utilizing the plate method is an effective strategy for educating people with T2D on food variety and portion sizes, aiding in dietary adherence.
Caloric restriction and balanced diets	Implementing caloric restrictions with balanced diets, including plant-based options, can improve overall health.
Individual meal planning	Meal frequency should be personalized to individual needs while maintaining an underlying principle of caloric restriction.
Sustainable dietary practices	Sustainable and evidence-based diets should be promoted over disruptive, unproven dietary approaches for long-term adherence and health benefits.
Intermittent fasting	While intermittent fasting may aid adherence in some cases, it is not inherently superior to caloric restriction and should not be universally recommended. It can be a valuable option for certain patients, but its suitability depends on individual preferences and needs rather than a one-size-fits-all approach.
Management of comorbidities	The Mediterranean and DASH diets are effective dietary approaches for managing dyslipidemia and hypertension, with recommendations tailored to individual macronutrient needs. For dyslipidemia management, the focus needs to be on increased fiber and plant sterols, replacing saturated fats with unsaturated options, and incorporating more plant proteins. Increased potassium intake up to 4700 mg/day may help control blood pressure.
Caloric beverages	Eliminating caloric nutrients from beverages supports better metabolic control.

Source: Own elaboration

Impact of Chrono-Nutrition on T2D

Chrono-nutrition is an emerging field of study dedicated to understanding the interaction between biological rhythms and nutrition, and how this affects human health. It involves the allocation of energy intake, the frequency and regularity of meals, the length of the eating window and the significance of these aspects

for metabolic health and the risk of developing chronic diseases (26).

A recent systematic review (27) included 11 crossover design studies, showing that eating in a prescribed order (vegetables first, followed by proteins, and carbohydrates last) can reduce postprandial glucose, glucose area under the curve (AUC), and glucose peaks, even in the short term and in individuals with or without diabetes. Although the effects are modest, this is an interesting strategy that can be combined with others, including carbohydrate reduction or choosing low-glycemic-index foods.

There is evidence of the association between the timing of food intake and glycemic responses or insulin resistance in people with T2D (28). The time of day when calories are consumed appears to be related to glucose control. For example, late-night eating and skipping breakfast negatively affect glucose metabolism (29). Higher carbohydrate consumption at breakfast was associated with a lower prevalence of T2D (OR = 0.75, 95% CI: 0.66–0.85), while an increase in lipid intake was linked to a 13% higher prevalence for each standard deviation increase (OR = 1.13, 95% CI: 1.01–1.26) (30). In addition, limiting food intake to a specific time window each day, typically less than 10 hours (Time-restricted feeding), improved glycemic control and reduced weight in people with T2D (31). Although promising, much of the evidence of chrono-nutrition-based interventions is still based on animal model research or observational data (32, 33). See consensus statements on Table 5.

Table 5. Consensus statements on impact of chrono-nutrition on T2D

Category	Statement
Daylight eating window	An eating window not exceeding 12 hours during daylight is generally advisable for maintaining metabolic balance. Aligning eating patterns with day/night cycle can potentially enhance metabolic control and should be considered in personalized dietary planning, though more evidence is required.
Optimal timing for caloric intake	A daily fast exceeding 8 hours is recommended for improved metabolic health, with most caloric intake in the morning to early afternoon. For better metabolic outcomes, consistent meal timing, including not skipping breakfast and maintaining a nightly fast of at least 12 hours, is recommended. Patients on treatment with hypoglycemic medications should adhere to regular mealtimes to mitigate risks associated with irregular eating patterns.
Metabolic concerns with shift work	Shift work potentially alters metabolism, increasing diabetes risk; achieving consistency in meal timing could mitigate these risks.
Macronutrient timing	Although the order of macronutrient intake (vegetables, followed by proteins and healthy fats, then finishing with carbohydrates) and elimination of snacks may offer glycemic benefits, evidence is currently insufficient to establish these as standard practices.

Source: Own elaboration

Interaction Between Medical Nutritional Therapy and Pharmacological Treatment for T2D

Type 2 diabetes treatment requires medication in almost every case, not only to improve glucose levels but also because certain medications specifically reduce the risk of disease progression or death in people with established cardiovascular disease, high cardiovascular risk, heart failure, kidney disease, or aid in weight reduction (34, 35).

Pharmacological treatment and MNT in people with diabetes can interact in several ways. Certain medications interfere with nutrient absorption, as is the case with metformin and vitamin B12 (30). Also, medications that may cause hypoglycemia should be taken with meals. Finally, gastrointestinal side effects, such as nausea, vomiting, and diarrhea, are common with certain pharmacological groups, and this could lead to impaired nutrition. See consensus statements on Table 6.

Table 6. Consensus statements on interaction between medical nutritional therapy and pharmacological treatment for T2D

Category	Statement
Carbohydrate and insulin synchronization	Effective glycemic control requires careful timing of insulin administration relative to meal intake, emphasizing pre-meal insulin boluses. Consistent carbohydrate intake and awareness of insulin action times are key for patients on fixed insulin doses to minimize the risk of hypoglycemia.
GLP1 Receptor agonists	Specific nutritional advice is necessary for patients using GLP-1 receptor agonists to mitigate gastrointestinal side effects.
Educating on hypoglycemia	Education on recognizing, managing, and preventing hypoglycemia is critical, particularly in patients receiving insulin or insulin secretagogues. Before adding snacks to prevent hypoglycemia, evaluate potential insulin overuse or excessive dosing.
Carbohydrate counting	Carbohydrate counting is essential for optimizing insulin dosing and glycemic control in patients with complex insulin regimens, particularly those on basal-bolus therapy.
High-fat/protein meals	Using continuous glucose monitoring data or self-monitoring in conjunction with carbohydrate counting may help adjust insulin for mixed meals high in fat or protein to prevent delayed hyperglycemia.
Pre-exercise glucose check	Patients on insulin or secretagogues should perform pre-exercise glucose checks and consume complex carbohydrates if levels are below 90 mg/dL.

Source: Own elaboration

Safety and Use of Sweeteners and Supplements in Individuals with T2D

The use of non-nutritive sweeteners (NNS) by people with T2D is a topic of ongoing discussion. Current guidelines, such as those from the American Diabetes Association, state the following: "Counsel people with diabetes and those at risk for diabetes that non-nutritive sweeteners can be used instead of sugar-sweetened products if consumed in moderation and for the short term to reduce overall calorie and carbohydrate intake"(23).

Short-term clinical trials indicate that NNS are safe and do not adversely affect blood glucose or insulin levels in people with T2D (36). However, evidence regarding their role in chronic weight management and weight reduction remains inconsistent (37). The World Health Organization recently issued a conditional recommendation against using NSS for weight control or reducing the risk of non-communicable diseases. This recommendation has faced criticism due to concerns about the quality of the evidence supporting it (38). Additional issues have been raised regarding the potential adverse effects of artificial sweeteners, including their impact on gut microbiota, gut hormone release (incretin effect), and possible associations with increased cardiovascular and cancer risks (39). Table 7 provides a list of commonly used NNS with their sweetness potency relative to sugar and maximum daily recommended dose.

Table 7. Common non-nutritive sweeteners

Name	Relative sweetness compared to sucrose	ADI (mg) for a 70kg person / mg in a 330 mL can of soda
Aspartame	180	3 500 / 28
Acesulfame-K	200	1 050 / 21
Saccharin	300	350 / 4
Sucralose	600	350 / 6
Neotame	7 000 – 13 000	18 / NA
Advantame	20 000	1 970 / NA
Steviosides	200 - 300	280 / 5

Note. ADI: Acceptable Daily Intake, NA: Information not available
Source: Adapted from Dwyer JT et al. (40)

Dietary supplements are a heterogeneous group of products that supplement the diet and usually contain one or more nutritional ingredients, such as vitamins, minerals, herbs, amino acids, and enzymes. In Colombia, there are different regulations for medications, dietary supplements, and specialized medical formulas; although limited, available market research suggests a high level of consumption among the general population, a trend also reported in other countries (41). The evidence relating to the role of supplements in people with T2D provides mostly low to very low certainty (42).

Special medical foods, such as nutrition formulas specifically designed for individuals with diabetes, are heavily marketed to support

T2D management and to complement MNT and pharmacological treatments. Diabetes-specific nutrition formulas (DSNF) are designed to help manage dysglycemia, malnutrition, and cardiometabolic risk factors in patients with T2D. These formulas contain low-glycemic index carbohydrates, fiber, unsaturated fats, proteins, vitamins, and minerals in controlled portions. Their macronutrient distribution—55% carbohydrates, 30–45% fats, and 15–19% proteins—is similar to that of the Mediterranean diet and aligns with guidelines from organizations like the American Diabetes Association (ADA). In contrast, standard nutrition formulas often include high-glycemic index carbohydrates and a variable fat composition, which can compromise glycemic control.

DSNF can be used as meal replacements, high-calorie supplements, or enteral nutrition, making them more suitable for the specific needs of patients with diabetes (43, 44). DSNF in small clinical trials have shown advantages over standard formulas, particularly in postprandial glucose control compared to isocaloric standard formulas (45, 46). Diabetes-specific meal replacements that use DSNF, when combined with a low-calorie diet and increased physical activity, have been shown to improve glucose control and body weight over a one-year period (47). The long-term benefits from DSNF are only sustained when combined with other lifestyle interventions (48, 49). See consensus statements on Table 8.

Table 8. Consensus statements on safety and use of sweeteners and supplements in individuals with T2D

Category	Statement
Non-caloric sweetener use	Non-caloric sweeteners may be used in the short term and if consumed in moderation, may enhance adherence to dietary guidelines and reduce fat mass in diabetic patients. However, their long-term impact should be evaluated. When used alone, sweeteners do not have a significant effect on metabolic control, so their consumption should be approached with caution. Reducing the intake of sweetened beverages and replacing them with non-caloric beverages whenever possible is recommended. While most sweeteners are safe, specific compounds such as saccharin and certain sugar alcohols should be avoided.
Specific supplement guidance	Supplement recommendations should not be universal; each product should be evaluated individually based on the related evidence on metabolic control improvement. Current evidence does not support using certain supplements, such as cinnamon, resveratrol, black cumin, beta-carotene, ginger, saffron, or Gymnema Sylvestre, for metabolic control. Patients should be informed about the potential risks associated with these products.
Special medical foods	Medical formulas for specialized nutrition can be used in patients experiencing malnutrition or severe caloric restrictions. These formulas serve as a suitable replacement for 1–2 meals per day or as a more long-term solution when necessary. Formulas enriched with monounsaturated fatty acids help improve glycemic control more so than standard options. The use of formulated nutrition products in individuals with diabetes should be assessed on a case-by-case basis, considering the individual's specific health needs and treatment goals.

Source: Own elaboration

Discussion

This paper generated consensus on different definitions and specific recommendations for medical nutritional therapy in people with type 2 diabetes, topics that are controversial because of inexisting or contradictory evidence, and some common issues that primary care healthcare providers face. Rather than offering a rigid set of instructions to standardize the treatment of all patients with T2DM, this document outlines general guiding principles that allow the individualization and adjustment of MNT for each individual patient.

Even though many current guidelines recognize the importance of Medical Nutrition Therapy in improving both metabolic control and quality of life and survival, recommendations regarding nutrition often remain too broad (50). The recent American Diabetes Association (ADA) guidelines and their Standards of Care advocate for a patient-centered approach, taking into account aspects related to social determinants of health (23). Another key focus of the latest guidelines is the importance of interprofessional teams in achieving sustainable changes that ultimately improve health outcomes and enhance patient adherence to various interventions.

Colombia's current healthcare system lacks a defined role for diabetes educators. Ensuring that healthcare providers who treat patients with type 2 diabetes receive adequate training is essential to effectively meet the needs of this population. In the management of MNT, experienced nutritionists should lead the process. To excel in this role, nutritionists must undergo training in accredited institutions and participate in continuous formal education to stay updated on the latest advancements and evidence-based practices.

These recommendations take into account societal and economic factors that influence adherence to MNT, especially in developing countries like Colombia. A population-based study in the five largest Colombian cities found a strong association between lower socioeconomic status or education, and increased intake of calories, carbohydrates and sodium, particularly among women (51). Importantly, an analysis of people with diabetes from the same study estimated that the proportion of those not meeting guideline-recommended nutrient goals was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber, and 80% for trans fats (52).

Colombia currently lacks recognized dietary patterns that have been proven to improve metabolic control in patients living with diabetes. However, some healthy dietary patterns, such as the Mediterranean diet, have shown favorable outcomes, including cardiovascular benefits (53). Many ingredients found in the Mediterranean diet may not be widely available or affordable for some patients, however, its basic principles—such as consuming low glycemic index foods, prioritizing non-processed foods, avoiding saturated fats, increasing the intake of polyunsaturated and monounsaturated fats, and incorporating fiber-rich foods—can be recommended using local and affordable ingredients until more local data becomes available.

Colombia is well-known for its biodiversity, which includes a wide variety of fruits and vegetables that are harvested and available year-round due to its privileged equatorial location. The establishment of healthy habits requires continuous education and empowering patients to choose healthier options. This education should involve frequent, quality interactions with patients, which policymakers and healthcare systems should value.

One important consideration to bear in mind when providing MNT to patients in insulin therapy is the importance to properly match insulin administration with the timing and magnitude of nutrient intake. When there is a mismatch between insulin dose (or timing), and nutrient intake (or timing), the patient may use defensive eating as a strategy against hypoglycemia, leading to progressive weight gain, impaired metabolic control, or both (54). The ratio of carbohydrate (and protein) intake per insulin unit is highly variable across patients and should be explored and determined empirically in many instances. Hypoglycemia can occur when there is a discrepancy between insulin dosage timing and food intake. A recent study highlights that this mismatch is one of the primary risk factors for severe hypoglycemia (55).

The suppression of all caloric contributions from dietary liquids is a desirable goal for most patients with diabetes and may provide a significant carbohydrate and calorie restriction in a single measure. Patients must be informed of the importance of food composition, rather than its origin, as a proxy for its health effects. For example, there is a widespread belief in the Colombian population, that drinks of "natural" origin but filled with simple carbohydrates, such as fruit juices or *aguadepanela* (an infusion of crystalized sugarcane juice), are healthy meal accompaniments (56). Of course, consuming such products has a highly negative impact on their metabolic control.

For individuals who frequently consume foods and beverages containing sugars, NNS can be a suitable substitute for caloric sweeteners, such as sugar, honey, and agave, when used in moderation. While NNS may not affect glycemic control, they can help improve overall health by reducing total caloric intake. Generally, NNS are considered safe; meta-analyses show no increase in liver enzymes associated with their consumption. However, findings regarding their impact on weight reduction are mixed, partly due to considerations of reverse causality and confounding variables (57–59). In the case of erythritol, there is some evidence suggesting a possible link to increased cardiovascular disease (60, 61). As for aspartame, there are concerns about its potential classification as a carcinogen in humans, although patients with diabetes were excluded from the systematic analysis (62, 63).

Combining the findings of a systematic review with insights derived from the Nominal Group Technique (NGT) integrates existing knowledge with expert opinions, facilitating the development of actionable recommendations for everyday clinical practice. Additionally, using highly detailed and reproducible methods promotes replication and enhances the quality of the results.

This consensus has several limitations. First, as with NGT, the ideas reflect only those of the expert panel, and different panels may arrive at different conclusions. While an effort was made to include a diverse panel, specific key stakeholders may not have been represented, potentially limiting the broader adoption of these recommendations. Finally, although the recommendations are grounded in a systematic review, they are ultimately based on expert opinions, making them susceptible to subjective interpretation and personal bias.

Conclusions

This expert consensus represents the first effort to clarify definitions and determine key components of medical nutrition therapy for individuals with type 2 diabetes. The panel achieved broad agreement across all topics. While developed by a group of Colombian specialists, its findings hold significant value for healthcare professionals, researchers, and clinicians, extending its relevance beyond Colombia.

Author´s contribution

Alejandro Marin-Sánchez: Conceptualization, Funding acquisition, Project administration, Writing – review & editing; Katherine Restrepo-Erazo: Conceptualization, Funding acquisition, Project administration, Writing – review & editing; Karen Palacios-Bayona: Conceptualization, Funding acquisition, Project administration, Writing – review & editing; Angelica Veloza-Naranjo: Writing – review & editing; Sandra Mora-Thiriez: Writing – review & editing; Lina M. Valencia: Writing – review & editing; Carlos O. Mendivil: Writing – review & editing.

Ethics

Due to the nature of this work, being a systematic review and an expert consensus, no specific ethical considerations were identified. The study did not directly involve patients, human participants, or animals, and was based exclusively on the review of scientific literature and contributions from multidisciplinary experts.

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Conflicts of interest

The authors declare no conflicts of interest regarding the subject of this work.

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