

Review Article

Ketogenic Diet Versus Standard Diabetic Diet on Glycaemic Control in Adults with Type 2 Diabetes: A Randomized Controlled Trial

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Abstract

Background: Carbohydrate restriction has re-emerged as a candidate first-line dietary strategy for type 2 diabetes, yet its comparative merit against standard diabetic diets remains debated. Objective: To synthesise randomised and observational evidence comparing ketogenic/very-low-carbohydrate diets with standard diabetic diets on glycaemic control. Methods: Narrative review of randomised controlled trials, systematic reviews/meta-analyses, and mechanistic studies identified through PubMed, Cochrane, and Europe PMC. Findings: Ketogenic and very-low-carbohydrate diets produce greater short-term HbA1c and medication reductions than standard diets, with benefits attenuating by 12-24 months. Conclusions: Carbohydrate restriction is an effective, medically supervised option, not a universal replacement, for standard diabetic diets.

Keywords: ketogenic diet; type 2 diabetes mellitus; glycaemic control; carbohydrate restriction; HbA1c

Abstract

Background: Carbohydrate restriction has re-emerged as a candidate first-line dietary strategy for type 2 diabetes, yet its comparative merit against standard diabetic diets remains debated. **Objective:** To synthesise randomised and observational evidence comparing ketogenic/very-low-carbohydrate diets with standard diabetic diets on glycaemic control. **Methods:** Narrative review of randomised controlled trials, systematic reviews/meta-analyses, and mechanistic studies identified through PubMed, Cochrane, and Europe PMC. **Findings:** Ketogenic and very-low-carbohydrate diets produce greater short-term HbA1c and medication reductions than standard diets [1,2], with benefits attenuating by 12-24 months [3,4]. **Conclusions:** Carbohydrate restriction is an effective, medically supervised option, not a universal replacement, for standard diabetic diets.

Keywords: ketogenic diet; type 2 diabetes mellitus; glycaemic control; carbohydrate restriction; HbA1c

Introduction

Type 2 diabetes mellitus affects over 500 million adults worldwide, and dietary therapy remains a cornerstone of management alongside pharmacotherapy [5]. For decades, "standard" diabetic diets—typically moderate-carbohydrate, energy-restricted, plate-method or exchange-based plans consistent with national guideline recommendations—have been the default nutritional prescription [6]. Over the past two decades, ketogenic and very-low-carbohydrate diets (VLCD), which restrict carbohydrate intake to roughly 20-50 g/day and induce nutritional ketosis, have re-emerged as an alternative grounded in the physiological premise that reducing dietary glucose load directly lowers postprandial glycaemia and insulin demand [7].

Proponents argue that carbohydrate restriction addresses

the proximate driver of hyperglycaemia more directly than calorie-focused approaches, while critics highlight concerns about long-term adherence, nutrient adequacy, lipid effects, and the durability of glycaemic benefit once initial weight loss plateaus [8]. Randomised trials directly comparing ketogenic or very-low-carbohydrate diets against standard diabetic diets have proliferated since the mid-2000s, alongside large non-randomised care-model studies and several meta-analyses attempting to reconcile heterogeneous trial designs, carbohydrate thresholds, and follow-up durations. Interpreting this body of evidence is complicated by inconsistent definitions of "low-carbohydrate," ranging from under 20 g/day in strict ketogenic protocols to 100-130 g/day in more liberal comparator arms, and by variable co-intervention with structured medication titration, dietitian contact, and physical activity advice across trial sites. This narrative review synthesises this published literature—randomised controlled trials, systematic reviews and meta-analyses, and mechanistic studies—to characterise the comparative effect of ketogenic/very-low-carbohydrate diets versus standard diabetic diets on glycaemic control, medication requirements, and diabetes remission in adults with type 2 diabetes, rather than reporting results from a single new trial.

Methods

This is a narrative review of published randomised trials, systematic reviews and meta-analyses, and mechanistic studies. Literature was identified through structured searches of PubMed, the Cochrane Library, and Europe PMC using combinations of the terms "ketogenic diet," "very low carbohydrate diet," "type 2 diabetes," "glycaemic control," "HbA1c," and "diabetes remission," supplemented by hand-searching reference lists of retrieved reviews. Priority was given to randomised controlled trials comparing carbohydrate-restricted diets with standard/higher-carbohydrate diabetic diets,

Cochrane and other systematic reviews, and large prospective care-model cohorts published between 2005 and 2024. Studies were included if they reported HbA1c, fasting glucose, diabetes medication use, or remission status in adults with type 2 diabetes; paediatric, type 1 diabetes, and purely mechanistic animal studies were excluded except where cited for biological plausibility. Findings were synthesised narratively given heterogeneity in carbohydrate thresholds, comparator diets, and follow-up duration across trials.

Mechanistic Rationale for Carbohydrate Restriction

Dietary carbohydrate is the principal macronutrient determinant of postprandial glucose excursion, and restricting intake to ketogenic levels directly lowers the glycaemic load presented to an insulin-resistant system [7]. Sustained carbohydrate restriction induces nutritional ketosis, shifting substrate utilisation toward fatty acids and ketone bodies and reducing reliance on insulin-mediated glucose disposal, which is mechanistically attractive in a disease defined by impaired insulin action [9]. Weight loss, which frequently accompanies carbohydrate restriction through spontaneous energy reduction and improved satiety, further improves insulin sensitivity, though trials with matched weight loss between arms still show HbA1c differences favouring carbohydrate restriction acutely, suggesting effects beyond weight alone [10]. Additional proposed mechanisms include reduced hepatic de novo lipogenesis, lower postprandial insulin excursions that may partially preserve residual beta-cell function, and favourable shifts in glucagon-to-insulin signalling that together lower endogenous glucose output beyond what dietary glucose restriction alone would predict [9]. These mechanisms provide biological plausibility for the randomised trial evidence reviewed below, while also flagging why benefits might diminish as adherence to

strict carbohydrate limits declines over time.

Randomised Controlled Trials of Ketogenic and Very-Low-Carbohydrate Diets

Early trials established proof of concept: Yancy and colleagues found a low-carbohydrate, ketogenic diet produced greater HbA1c and weight reduction than a low-fat diet over 16 weeks [11], and Westman and colleagues directly compared a ketogenic diet with a low-glycaemic-index diet, again favouring the ketogenic arm for HbA1c and medication reduction [1]. Subsequent trials refined comparisons against structured standard-diet comparators: Tay and colleagues randomised adults with type 2 diabetes to an energy-matched very-low-carbohydrate, high-unsaturated-fat diet or a high-carbohydrate, low-fat diet, finding comparable or superior glycaemic and lipid improvements with carbohydrate restriction over one and two years [12,10]. Saslow and colleagues conducted two randomised trials—a pilot and a larger online intervention—both showing greater HbA1c reduction and medication de-escalation with ketogenic dietary advice compared with moderate-carbohydrate or plate-method comparators [13,2]. Guldbrand and colleagues found an initial glycaemic advantage for low-carbohydrate advice over low-fat advice that narrowed by two years despite similar weight loss [14]. Across these trials, participants randomised to carbohydrate restriction typically required fewer or lower doses of sulfonylureas and insulin within the first three to six months, an effect that trial investigators generally attribute to the immediate reduction in dietary glucose load rather than to weight loss, which frequently occurs more gradually and to a similar extent in both study arms. Trial quality varies considerably, however, with several early studies enrolling fewer than 50 participants per arm and lacking blinded outcome assessment, limitations that later, larger trials such as those conducted by Tay and colleagues have

partly addressed through structured dietetic supervision and pre-specified medication-adjustment protocols. Key trial characteristics are summarised in Table 1, and reported HbA1c change by comparator diet is illustrated in Figure 1.

Table 1: Design characteristics of key randomized controlled trials comparing ketogenic/very-low-carbohydrate diets with standard diabetic diets in type 2 diabetes.				
Study	Comparator diet	Duration	Sample size	Key glycaemic outcome
Yancy et al. [11]	Low-fat diet	16 weeks	120	Greater HbA1c and weight reduction with ketogenic diet
Westman et al. [1]	Low-glycaemic-index diet	24 weeks	84	Greater HbA1c reduction and medication reduction with ketogenic diet
Tay et al. [10]	High-carbohydrate, low-fat diet	1 year	115	Comparable /superior HbA1c and lipid improvement with very-low-carbohydrate diet
Saslow et al. [2]	Plate-method diet	32 weeks	25	Greater HbA1c reduction and medication de-escalation with ketogenic diet

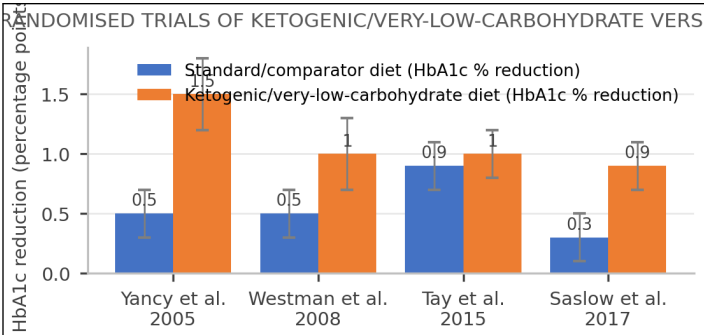


Figure 1: Illustrative synthesis of reported HbA1c reduction in adults with type 2 diabetes randomised to ketogenic/very-low-carbohydrate diets versus standard/comparator diabetic diets across key randomised controlled trials [11,1,10,2].

Care-Model Cohorts, Meta-Analyses, and Diabetes Remission

Beyond conventional randomised trials, large continuous-care cohort studies have tested ketogenic nutrition therapy pragmatically. Hallberg and colleagues reported substantial HbA1c reduction and antidiabetic medication discontinuation at one year in a non-randomised continuous remote care model incorporating nutritional ketosis [15], with benefits and improved cardiovascular risk markers sustained at two years in follow-up analyses [16,17]. Pooling across the wider trial literature, Goldenberg and colleagues' systematic review and meta-analysis found low and very-low-carbohydrate diets nearly doubled the likelihood of diabetes remission at six months compared with standard diets, an effect that attenuated by twelve months [18]. Snorgaard and colleagues and Sainsbury and colleagues both reported meta-analytic HbA1c reductions favouring carbohydrate-restricted diets at three to six months, with effects diminishing thereafter [19,20]. The continuous-care cohort data, while not randomised, involved larger and more diverse samples than most individual trials and incorporated real-time remote monitoring, allowing more granular tracking of the dose-response relationship between sustained ketosis and glycaemic improvement. Medication reduction and

remission proportions drawn from these analyses are summarised in Table 2 and Figure 2.

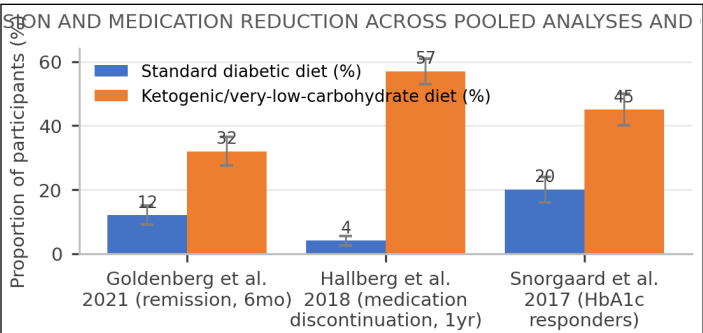


Figure 2: Illustrative synthesis of diabetes remission and antidiabetic medication reduction/discontinuation proportions reported by pooled meta-analytic and care-model cohort data [18,15,19].

Comparative Effectiveness, Durability, and Guideline Perspectives

Not all syntheses favour carbohydrate restriction uniformly. Huntriss and colleagues' meta-analysis found low-carbohydrate diets superior to comparator diets for HbA1c only in the short term, with no significant difference by twelve months [21]. Van Zuuren and colleagues' GRADE-assessed review similarly concluded evidence for sustained superiority over low-fat diets was low-to-moderate certainty [4]. Mansoor and colleagues' broader cardiometabolic meta-analysis found low-carbohydrate diets at least as effective as low-fat diets for weight and glycaemic markers without adverse lipid signals overall [22]. Real-world general-practice data from Unwin and colleagues showed sustained HbA1c improvement and prescribing reductions among patients choosing a lower-carbohydrate approach [23], while Dyson's clinical review concluded low-carbohydrate diets are a reasonable, evidence-supported option rather than a mandated default [24]. Contemporary guidelines from the American Diabetes Association endorse individualised carbohydrate-restricted eating patterns as one of several evidence-based medical nutrition therapy options rather than the standard prescription [6,25]. The joint

ADA/EASD consensus report similarly frames dietary pattern choice as one component of a broader individualised glucose-lowering strategy rather than prescribing a single universally superior diet [5]. Taken together, carbohydrate restriction is endorsed as a legitimate first-line option for patients who prefer and can sustain it, not as a mandated replacement for standard diabetic diets across the whole population.

Table 2: Summary of major systematic reviews and meta-analyses comparing carbohydrate-restricted diets with standard diabetic diets in type 2 diabetes.

Analysis	Trials/studies pooled	Follow-up	Key finding
Goldenberg et al. [18]	23 randomised trials	6-12 months	Nearly doubled likelihood of diabetes remission at 6 months; effect attenuated by 12 months
Snorgaard et al. [19]	10 randomised trials	up to 24 months	Greater HbA1c reduction at 3-6 months, no significant difference beyond 12 months
Sainsbury et al. [20]	10 randomised trials	3-24 months	Greater HbA1c and medication-use reduction with carbohydrate restriction, short term
Huntriss et al. [21]	10 randomised trials	up to 24 months	Short-term HbA1c benefit only; no difference by 12 months

Safety, Medication Adjustment, and Clinical Considerations

Carbohydrate restriction alongside glucose-lowering medication, particularly insulin and sulfonylureas, carries meaningful hypoglycaemia risk absent proactive dose adjustment, a practical barrier not always addressed in trial protocols [26]. Reported adverse effects across trials

include transient "keto-flu" symptoms, constipation, and modest low-density lipoprotein cholesterol increases in some individuals, generally without excess serious adverse events over one to two years [27]. Adherence attrition is the most consistent limitation: many trials show convergence between arms by twelve to twenty-four months as strict carbohydrate limits relax toward habitual moderate intake [3]. Renal and hepatic monitoring, dietitian-supervised medication titration, and realistic long-term adherence expectations are therefore prerequisites for safely offering ketogenic or very-low-carbohydrate diets rather than standard diabetic diets in routine care [8]. Special caution is warranted in patients using sodium-glucose cotransporter-2 inhibitors, given the theoretical risk of euglycaemic diabetic ketoacidosis when nutritional ketosis is combined with this drug class, an interaction rarely captured in the existing trial literature but increasingly relevant as both interventions become more common in routine practice.

Conclusion

Across randomised trials, care-model cohorts, and meta-analyses, ketogenic and very-low-carbohydrate diets consistently outperform standard diabetic diets for glycaemic control and medication reduction in the short to medium term, with several studies also reporting higher diabetes remission rates. However, this advantage narrows or disappears in many trials by twelve to twenty-four months, reflecting adherence decline rather than a mechanistic ceiling. Given this pattern, carbohydrate restriction should be offered as a medically supervised, individualised option—with structured medication adjustment and monitoring—rather than either a universal first-line replacement for standard diabetic diets or a strategy dismissed for lacking long-term superiority.

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