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Comparative Effectiveness of Low-Carbon and Balanced Diet In Type 2 Diabetes Mellitus

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Abstract: This article presents a review of the comparative effectiveness of low-carbohydrate and balanced carbohydrate diets in type 2 diabetes. The results of randomized controlled trials and meta-analyses published between 2014 and 2025 were analyzed, assessing the impact of diets on glycated hemoglobin levels, body weight, and lipid profiles. Both diets were found to reduce HbA1c and body weight, with minimal differences between them.

Keywords: Type 2 diabetes mellitus, low-carbohydrate diet, balanced diet, glycated hemoglobin, body weight, lipid profile, diet therapy.

Introduction: Scientific novelty. This article presents the first systematic comparative analysis of the short-term and long-term effectiveness of low-carbohydrate and balanced carbohydrate diets in patients with type 2 diabetes, focusing on HbA1c levels, body weight, and lipid profiles. Particular attention is paid to the impact of diets on patient adherence and the long-term sustainability of clinical effects, which allows for the justification of an individualized approach to dietary therapy for type 2 diabetes.

Type 2 diabetes mellitus (T2DM) is one of the most widespread chronic noncommunicable diseases, representing a serious global challenge. According to the World Health Organization (WHO), the number of people with T2DM exceeds 480 million, with further growth projected in the coming decades [1]. T2DM is characterized by a combination of insulin resistance and a relative deficiency of insulin secretion, leading to chronic hyperglycemia and the development of multiple vascular complications [2].

Non-drug therapy, particularly dietary intervention, remains a cornerstone in the comprehensive management of patients with type 2 diabetes [3]. Lifestyle modification aimed at weight loss and optimization of carbohydrate metabolism has been shown to improve glycemic control, reduce the risk of cardiovascular complications, and in some cases achieve disease remission [4].

In recent years, low-carbohydrate diets, which limit daily carbohydrate intake to 20–50 g per day, have attracted particular attention from researchers and clinicians. Several studies have shown that such diets can lead to significant reductions in glycated hemoglobin (HbA1c) levels, improved insulin sensitivity, and more rapid weight loss compared to traditional diets [5]. At the same time, balanced carbohydrate diets, including moderate carbohydrate intake (45–55% of total calories), are based on healthy eating principles and are better tolerated by patients in the long term [6].

Despite extensive research, the comparative long-term effectiveness of LCD and BCD in type 2 diabetes remains a subject of active scientific debate. Clinical data demonstrate both short-term benefits of LCD and comparable results with BCD during long-term follow-up [7]. The choice of optimal strategy should consider not only metabolic effects but also long-term adherence and dietary safety.

The aim of this article is to analyze and compare the effectiveness of low-carbohydrate and balanced carbohydrate diets in type 2 diabetes mellitus according to key clinical and metabolic criteria: glucose control (HbA1c, FPG), changes in body weight and lipid profile dynamics.

Methodology. The review is based on an analysis of data from randomized controlled trials (RCTs) and

meta-analyses published between 2014 and 2025 on the comparative effectiveness of low-carbohydrate and balanced carbohydrate diets in patients with type 2 diabetes. A search of publications was conducted in the PubMed, Scopus, and Cochrane databases. Library using the keywords: «low-carbohydrate diet» , «balanced diet», «type 2 diabetes», «glycemic control», «weight loss», «RCT», «meta-analysis».

Inclusion criteria: studies involving adults with type 2 diabetes; at least 12 weeks of follow-up; comparison of low-carbohydrate and balanced diets; availability of data on HbA1c, fasting glucose, body weight, or lipid profile.

Exclusion criteria: studies involving patients with type 1 diabetes, pregnant women, and studies with insufficient methodological quality.

The data were systematized taking into account the duration of observation (short-term - up to 6 months and long-term - from 12 months), dietary intervention methods and clinical outcomes.

Results

1. Glycemic control (HbA1c and fasting glucose). Most of the included studies demonstrated improvements in glycemic control with both the low-carbohydrate (LC) and balanced-carbohydrate (BC) diets, but no statistically significant differences were found between the groups over the long term.

Meta-analysis in the article «Efficacy and safety of low and very low carbohydrate diets for type 2 diabetes remission: systematic review and meta-analysis of published and unpublished randomized trial data», which included 23 RCTs with 1357 participants, showed that after 3–6 months, the NU diet was associated with a reduction in HbA1c by 0.47% (95% CI: 0.26–0.68) compared with the SU diet, but after 12 months the difference decreased and became statistically insignificant (difference 0.10%; 95% CI: –0.08 to 0.28) [8].

Similar results were obtained in the article «Low - carbohydrate diets compared with balanced diets for glycemic control in adults with type 2 diabetes: Cochrane systematic review and meta-analysis», where after 6 months of observation, fasting glucose levels decreased by an average of 1.2 mmol /l in the NU group and by 1.0 mmol /l in the SU group, and after 12 months the indicators leveled off [9].

It is also noted that a pronounced effect of NU diets is observed in patients with higher initial HbA1c levels and with strict adherence to carbohydrate restrictions.

2. Body weight. Weight loss was recorded in all studies, regardless of diet type. According to a meta-analysis including 18 RCTs with 2140 participants, the NU diet provided a more significant weight loss in the first 3–6 months (on average –5.4 kg), while the SU diet provided 3.8 kg [10].

After 12 months, the differences between the groups narrowed (-4.1 kg vs. -3.7 kg, p>0.05). Diet adherence had a significant impact on body weight dynamics. Participants who strictly adhered to the NU diet demonstrated more significant changes in body weight.

3. Lipid profile. The results of the effect of NU diets on lipid metabolism are mixed. In the short term (3–6 months), a significant decrease in triglyceride levels (on average –0.31 mmol /L) and a moderate increase in HDL were observed in the NU group compared to the SU group [11]. However, after 12 months, the differences leveled out.

Total cholesterol and LDL levels in most studies did not demonstrate clinically significant differences between diets. Some studies note a slight increase in LDL with the HCV diet, which requires an individual risk assessment [12].

4. Long-term effects and diet adherence. Several studies indicate that the short-term benefits of NU diets for weight loss and HbA1c often diminish as adherence to the diet worsens over the course of a year [13]. Balanced diets, on the other hand, demonstrate more consistent adherence and acceptability in the long term.

Table 1 - Comparison of the effects of low-carbohydrate and balanced diets in patients with type 2 diabetes (based on RCTs and meta-analyses)

Indicator	Low-carbohydrate diet (LCD)	Balanced diet (BD)
Reduction of HbA1c, 3–6 months	–0.47% (95% CI: 0.26–0.68)	-0.31%
HbA1c reduction, 12 months	-0.32%	-0.28%
Fasting glucose, 6 months	–1.2 mmol /l	–1.0 mmol /l
Weight loss, 6 months	-5.4 kg	-3.8 kg
Weight loss, 12 months	-4.1 kg	-3.7 kg
Triglycerides, 6 months	↓ 0.31 mmol /L	↓ 0.21 mmol /L
LDL	Minor changes	Minor changes
Diet adherence, 12 months	Decreases in some patients	Steadily higher

Discussion

The results of the analysis show that both low-carbohydrate (LC) and balanced-carbohydrate (BC) diets have a positive effect on glycemic control, body weight, and metabolic profile in patients with type 2 diabetes. While the short-term benefits of LC diets are more pronounced, over the long term, the differences between the dietary approaches become statistically insignificant.

1. Glycemic control. Short-term results of meta-analyses have shown that NU diets promote a more pronounced reduction in HbA1c and fasting glucose levels in the first 3–6 months compared to SU diets. This is explained by a rapid reduction in postprandial glycemia due to carbohydrate restriction, as well as improved insulin sensitivity. However, after 12 months, the differences between groups level out, which is consistent with data from other large meta-analyses . The main reason is the decreasing patient adherence to strict carbohydrate restriction over time. Furthermore, some studies show that the response to the NU diet is individual and depends on the initial HbA1c level, disease duration, and residual pancreatic β- cell function.

2. Body weight and lipid profile. RCTs and meta-analyses have shown that NU diets result in more significant weight loss in the first few months, which may be due to both the reduced caloric intake and increased diuresis and glycogen loss during the initial period. However, after one year, weight loss results become similar to those in the SU diet group, confirming the importance of not only choosing the right diet but also maintaining it over the long term.

Changes in lipid profile were moderate. The NC diet group showed a more pronounced reduction in triglyceride levels and an increase in HDL cholesterol in the first 6 months, consistent with the metabolic effect of carbohydrate restriction. However, long-term differences between the diets in LDL and total cholesterol levels were minor. Some studies have noted a slight increase in LDL cholesterol in some patients on the NC diet, necessitating an individualized assessment of cardiovascular risk when choosing a nutritional strategy.

3. Adherence and sustainability of effect. One of the key factors in the success of dietary therapy is patient adherence to the chosen strategy. Despite the proven effectiveness of NU diets in the short term, their long-term adherence is difficult for many patients due to dietary restrictions and difficulties with social adaptation. Balanced diets based on healthy eating principles are generally easier to maintain over the long term, making them a more sustainable tool for managing type 2 diabetes at the population level.

4. Clinical significance and application. Current clinical guidelines, including American Diabetes Association (ADA) and European Association for the Study of The European Association of Diabetes Standards (EASD) recognizes both low- and low-calorie diets as acceptable and effective for type 2 diabetes, emphasizing the need for individualized approaches. Low-calorie diets may be particularly beneficial for patients with severe hyperglycemia and obesity, especially during the first months of treatment, while low-calorie diets are beneficial for patients who need to maintain a stable diet without strict restrictions. It is also important to note that neither diet replaces a comprehensive approach that includes physical activity, medication, and self-management training.

Consequently, low-carbohydrate diets provide greater improvements in glycemic control and body weight in the first 3–6 months compared to balanced diets. After 12 months, the differences between the diets even out, primarily due to differences in adherence. Balanced diets are better tolerated and easier to maintain long-term. The choice of dietary strategy should be personalized, taking into account the patient's clinical characteristics, lifestyle, and preferences.

Thus, the choice of dietary strategy for type 2 diabetes should be individualized, taking into account the patient’s clinical characteristics, baseline HbA1c level and body weight, comorbidities, personal preferences and ability to adhere to the diet.

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