LIFE Science Hub
JOURNAL OF SCIENCE
EXPANDING KNOWLEDGE ABOUT NUTRITION AND HEALTH

ORIGINAL RESEARCH

Carbohydrate restriction and metabolism in type 2 diabetes: metabolic and hormonal effects

M. Moscati[1]

1 Italy

1. ABSTRACT

The analyzed study evaluated whether six weeks of a diet with a lower carbohydrate intake and a higher protein intake could modify the meal response in 28 people with type 2 diabetes. Compared to a conventional diabetes diet, the regimen with 30% of energy from carbohydrates reduced post-meal glycemic excursion by 60% and 24-hour average glycemia by 13%. Postprandial insulin secretion and certain markers of proinsulin processing also decreased, while indirect indices of pancreatic beta-cell response improved.The publication contributes to the narrative of "The Choice to Live in Health or Illness" by Dr. A. Colonnese and R. Panzironi, according to which a moderate carbohydrate restriction can make the glycemic response more gradual, reduce insulin requirements, and increase satiety. A slowing of gastric emptying was observed, but the abstract does not document an increase in incretins: GIP decreased, and GLP-1, peptide YY, and cholecystokinin did not change significantly. Independent trials and meta-analysis confirm, above all, the short-term improvement in glycemia and certain indices of beta-cell function; long-term evidence is less clear-cut. The conclusion is therefore moderately supported, but requires larger and more prolonged studies.

ONLINE ARTICLE

ARTICLE INFORMATION

Published: November 13, 2026
Updated: November 13, 2026

DOI 10.5281/zenodo.24204850

MISSION

LIFE Science Hub – Journal of Science was founded with the aim of making scientific knowledge accessible without giving up methodological rigour, quality of sources and authoritativeness of content. The journal promotes the dissemination of knowledge in the health, nutrition, medical and longevity sciences, building a bridge between the world of research and society.

Through articles, reviews, in-depth analyses and expert contributions, the Journal champions evidence-based medicine and science, fostering a correct interpretation of scientific data and countering misinformation. Every piece of content is developed with the aim of translating the complexity of research into understandable, useful and applicable information, while keeping intact the principles of accuracy, transparency and scientific independence.

Free from political, industrial and commercial influence, the journal stands as an authoritative and independent editorial space, dedicated to promoting scientific culture, professional development and the growth of health awareness among the public.

2. ANALYZED STUDY

The research question was whether a moderate reduction in carbohydrates, compensated by more protein and fat, would change how the body manages glucose after meals in people with type 2 diabetes. The hypothesis was that a lower carbohydrate intake would reduce glycemic variability and lighten the secretory workload of pancreatic beta cells, which are the cells that produce insulin.The reason for the citation in paragraph 2.3 and paragraph 14.4 of "The Choice to Live in Health or Illness" by Dr. A. Colonnese and R. Panzironi is specific: the study documents that, in an isocaloric dietary comparison, reducing the carbohydrate portion can lower the post-meal glucose spike, reduce average 24-hour glycemia, decrease postprandial insulin secretion, and increase satiety.The research can demonstrate metabolic differences observed in the short term, under controlled dietary conditions, between the two dietary regimens. However, it cannot prove that the diet prevents pancreatic deterioration in the long term, that it reduces diabetes complications, or that the effects are identical in all people with type 2 diabetes.

3. MATERIALS AND METHODS OF THE ORIGINAL STUDY

The study used a randomized crossover design: the same participants followed both dietary regimens in separate periods. Twenty-eight people with type 2 diabetes, with an average glycated hemoglobin of 60 mmol/mol, were assigned in random order to six weeks of a low carb, high-protein diet, followed by six weeks of a conventional diabetes diet, or in the reverse sequence.The carbohydrate-restricted diet provided 30% of energy from carbohydrates, 30% from protein, and 40% from fat. The conventional diet provided 50%, 17%, and 33%, respectively. The available material does not report the washout period between the two interventions, the full inclusion and exclusion criteria, or the details of the statistical analyses.The researchers used continuous glucose monitoring—a sensor that repeatedly records glycemia throughout the day—and mixed-meal tests. They measured glycemia, insulin secretion, several indicators of beta-cell function, glucagon, and gut hormones. Gastric emptying, which is the speed at which stomach contents reach the intestine, was estimated through post-meal paracetamol concentrations. Satiety was assessed using visual scales completed by the participants.

4. RESULTS

The most immediate result for the reader is that, after six weeks, the low carb regimen produced significantly lower glycemic spikes after meals. The net area under the postprandial glucose curve, a measure of overall glucose exposure after a meal, was reduced by 60% compared to the conventional diet ($P < 0.001$). The average 24-hour glycemia, recorded by the sensor, also decreased by 13% ($P < 0.001$).The low carb diet also reduced the post-meal insulin secretion rate by 24% ($P = 0.015$). This data indicates that a lower secretion of insulin was required to manage a smaller amount of available glucose after the meal; it does not, by itself, demonstrate a permanent recovery of pancreatic function. Fasting concentrations of intact proinsulin and 32,33-split proinsulin also decreased; these are markers that, when elevated, can reflect less efficient processing of the hormone.Two estimated indices of beta-cell function improved: the insulinogenic index, which describes the early insulin response to glucose, increased by 31%, while beta-cell sensitivity to glucose increased by 45%; for both, $P < 0.001$. Postprandial glucagon, on the other hand, increased by 235% ($P < 0.001$), an effect that requires cautious interpretation because glucagon tends to increase hepatic glucose production.Regarding gastrointestinal mechanisms, gastric emptying was delayed by 15 minutes ($P < 0.001$) and subjective satiety increased by 18% ($P = 0.03$). GIP, an incretin gut hormone that can promote insulin secretion, decreased by 29% ($P < 0.001$). No significant differences emerged for GLP-1, total peptide YY, or cholecystokinin. Consequently, the result does not support the idea of a general increase in incretins during this specific intervention.

5. INTERPRETATION

Overall, the study suggests that a lower intake of carbohydrates limits the amount of glucose that rapidly enters the bloodstream after meals. This change is consistent with a reduction in glycemic spikes and a lower insulin secretion required to manage them. The improvement in beta-cell function indices and proinsulin processing markers is

compatible with a more efficient pancreatic response in the studied context.The segment of the narrative chain actually documented is: lower carbohydrate availability in the meal lower postprandial glycemic excursion and lower 24-hour glycemia lower postprandial insulin secretion, with an improvement in some estimated indices of beta-cell function. Delayed gastric emptying represents an additional plausible mechanism that can distribute glucose absorption more gradually.However, the interpretation must remain proportionate to the data. The study does not prove that the pancreas was "protected" in the long term, nor that chronic glucotoxicity has decreased, which would require prolonged measurements and clinical outcomes. Furthermore, the statement in the book regarding increased incretin secretion must be contextualized: in the analyzed study, GIP decreased, and the responses of GLP-1, peptide YY, and cholecystokinin did not show significant variations.

6. INDEPENDENT CONFIRMING EVIDENCE

Direct confirmation of the passage regarding beta-cell function comes from an independent 12-week randomized trial conducted in 57 adults with type 2 diabetes not treated with insulin. With equal energy intake, a diet with approximately 9% of energy from carbohydrates was compared to a 55% carbohydrate diet. The early C-peptide response to glucose, an indicator of initial insulin secretion, was approximately doubled with the low carb diet; the maximal response was 22% higher, and the disposition index, which integrates insulin secretion and insulin sensitivity, increased by 32% [1]. The study is relevant because it uses robust dynamic measures, but it remains limited to twelve weeks and to people with relatively mild diabetes.A second independent crossover study helps clarify the possible gastrointestinal contribution. Eight people with type 2 diabetes consumed a portion of whey protein before a carbohydrate-rich meal. Gastric emptying was slower, and incremental glucose exposure was lower compared to the meal without protein. Insulin, GIP, and cholecystokinin also increased; GLP-1 was highest when proteins were consumed before the meal [2]. This does not replicate the diet of the original study, nor does it prove that all effects depend on incretins, but it confirms in a biologically consistent way that proteins and gastric emptying can contribute to attenuating postprandial glycemia.On a larger scale, a meta-analysis of ten randomized trials and 1,376 participants with type 2 diabetes found, within the first year, an average glycated hemoglobin 0.34 percentage points lower with low or moderate carb diets compared to higher carbohydrate diets. Greater carbohydrate restriction was associated with a greater reduction in glycemia [3]. This synthesis confirms the direction of the effect on glycemia, but does not allow for attributing the benefit exclusively to the lower amount of carbohydrates: proteins, fats, diet quality, medications, and adherence also changed.

7. CONFLICTING EVIDENCE

Conflicting evidence primarily concerns the duration of the effect, not the fact that a reduction in carbohydrates can attenuate glycemic spikes in the short term. A 2024 meta-analysis included six randomized trials with interventions lasting longer than twelve months and found no significant difference in glycated hemoglobin between low-carb diets and control diets: standardized mean difference −0.11, 95% confidence interval from −0.33 to 0.11; P = 0.32. No significant differences emerged for weight, blood pressure, or LDL cholesterol either [4].This evidence does not directly contradict the acute or six-week results of the analyzed study, as it evaluates a different time horizon and different outcomes. However, it reduces the certainty that the initial glycemic advantage automatically persists in the long term. Differences between studies may depend on the definition of “low carb,” the composition of replacement nutrients, adherence, adjustments to pharmacological therapy, and the baseline characteristics of the participants.

8. QUADRO COMPARATIVO E SINTESI DELLE EVIDENZE

The table distinguishes the data from the publication subject to the review from independent confirmations and the main conflicting evidence regarding the duration of the glycemic effect.

Quadro comparativo

Reference	Study type	Population or model	Main result	Direction of evidence	Strength of evidence
Original study	Randomized crossover trial	28 people with type 2 diabetes; six weeks per diet	60% reduction in postprandial glycemic excursion and 13% in 24-hour glycemia; lower insulin secretion and greater satiety	direct confirmation	moderate
[1]	Isocaloric RCT	57 adults with type 2 diabetes; 12 weeks	Diet with approximately 9% energy from carbohydrates increased early C-peptide response and disposition index	direct confirmation	moderate
[2]	Experimental crossover study	8 people with diet-controlled type 2 diabetes	A protein preload slowed gastric emptying and reduced postprandial glycemia	biologically consistent evidence	low
[3]	Systematic review and meta-analysis of RCTs	10 trials; 1,376 people with type 2 diabetes	Within one year, glycated hemoglobin was 0.34 percentage points lower with lower carbohydrate intake	indirect confirmation	moderate
[4]	Systematic review and meta-analysis of RCTs	6 trials with duration longer than 12 months in adults with type 2 diabetes	No significant difference in glycated hemoglobin between low carb diet and controls	discordant evidence	moderate

9. SINTESI EDITORIALE E CONCLUSIONI

CONCLUSIONS

The study analyzed shows that six weeks of a diet with 30% of energy from carbohydrates, compared to a conventional diet higher in carbohydrates, substantially reduced post-meal glycemic spikes and average daily glycemia in people with type 2 diabetes. The lower postprandial insulin secretion, the improvement in certain beta-cell indices, and increased satiety are consistent with a lower immediate metabolic load.Independent evidence moderately confirms that carbohydrate restriction can improve short-term glycemic control and certain aspects of the pancreatic response. The slowing of gastric emptying is a plausible and experimentally supported mechanism. However, it is not correct to extend these data to a generalized increase in incretins, nor to infer pancreatic protection or certain

long-term glycemic superiority. The sustainability of the dietary pattern, the quality of substitute nutrients, and the adjustment of therapy remain essential elements to be evaluated on an individual basis.

Aggiornato al 17/11/2026. Questo contenuto riflette una sintesi divulgativa delle evidenze scientifiche al momento della pubblicazione e non sostituisce il parere medico.

10. TRANSPARENCY AND SCIENTIFIC RESPONSIBILITY

Artificial Intelligence was used solely as a tool for editorial and documentary support. All content, interpretations, bibliographic citations and conclusions have been verified, reviewed and approved by the author, who assumes full scientific responsibility for them.

The manuscript was also subjected to independent peer review prior to publication.

To ensure the greatest transparency, the complete history of the article, including the dates of submission, revision, acceptance and publication, as well as information on the peer review process, is available on the dedicated Article History page.

11. RIFERIMENTI BIBLIOGRAFICI

[1] **Effects of a Carbohydrate-Restricted Diet on b-Cell Response in Adults With Type 2 Diabetes**
Gower et al., 2025
The Journal of Clinical Endocrinology & Metabolism
DOI: https://doi.org/10.1210/clinem/dgae670

[2] **Effects of a Protein Preload on Gastric Emptying, Glycemia, and Gut Hormones After a Carbohydrate Meal in Diet-Controlled Type 2 Diabetes**
Ma et al., 2009
Diabetes Care
DOI: https://doi.org/10.2337/dc09-0723

[3] **Systematic review and meta-analysis of dietary carbohydrate restriction in patients with type 2 diabetes**
Snorgaard et al., 2017
BMJ Open Diabetes Research & Care
DOI: https://doi.org/10.1136/bmjdrc-2016-000354

[4] **Efficacy of long term low carbohydrate diets for patients with type 2 diabetes: A systematic review and meta analysis**
Ichikawa et al., 2024
Journal of Diabetes Investigation
DOI: https://doi.org/10.1111/jdi.14271