

How Low Can You Go? Does Lower Carb Translate to Lower Glucose?

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I once asked the father of 1 of my patients with type 1 diabetes (T1D) to reflect on the advice provided to his family at diagnosis by the diabetes team, and he responded: “You should never have told us that our son can eat anything he wants. It’s just not true.” He was referring to the nutrition education provided, in which we typically tell families that any carbohydrate can simply be matched by insulin. This is reflective of the fact that endocrinologists have traditionally focused on the adjustment of insulin rather than diet as a primary means for controlling glucose levels; for example, the 2018 Standards of Medical Care in Diabetes for children and adolescents does not even address dietary management.¹ This gap is partly due to the lack of evidence regarding outcomes of optimal dietary strategies for improving glycemia in T1D. This is why the recent study by Lennerz et al,² in which they looked at glycemic outcomes of individuals with T1D on a very low-carbohydrate diet (VLCD), is an important contribution to the literature.

The authors enrolled 316 participants from a closed Facebook community of adults with T1D and parents of children with T1D who follow recommendations outlined in the book *Dr Bernstein’s Diabetes Solution*.³ Only participants who self-reported following the recommendation for a VLCD (≤ 30 g per day from mostly fibrous vegetables and nuts) for at least 3 months before the study were enrolled. Data collected from patient surveys were validated with medical records and provider surveys, and the authors took a rigorous approach to

ensure confidence of a true diabetes diagnosis based on age at diagnosis, BMI, positive results for diabetes antibodies, and insulin requirements immediately after diagnosis. Adult participants reported following the VLCD for a mean of 2.7 ± 3.6 years, with a mean daily carbohydrate intake of 36 ± 16 g. In the pediatric group, the mean VLCD duration was 1.4 ± 1.2 years, and the mean daily carbohydrate intake was 36 ± 14 g.

Before the initiation of the VLCD, the mean hemoglobin A1c (HbA1c) for all participants was $7.15\% \pm 1.15\%$. At the time of data collection, the mean reported HbA1c for all participants was $5.67\% \pm 0.66\%$, and it was $5.71\% \pm 0.58\%$ for the 131 pediatric participants, which is an exquisite level of control. Among a subset of patients who used continuous glucose monitoring, the mean reported blood glucose value was 102 ± 17 mg/dL with an SD of 26 ± 12 mg/dL for adults ($n = 64$) and 107 ± 15 mg/dL with an SD of 29 ± 12 mg/dL for kids ($n = 51$). Authors of previous studies of the VLCD have found comparable decreases in HbA1c, albeit not as dramatic. Researchers of 1 study investigated the change in HbA1c 4 years after attending an educational course that recommended dietary carbohydrate reduction to ≤ 75 g per day, with an HbA1c decrease from $7.8\% \pm 1.0\%$ to $6.0\% \pm 0.6\%$.⁴ However, this study was small, with only 13 adherent participants. Authors of another study of individuals who were on a carbohydrate-restricted diet of 30 g per day for 8 months to 61 months reported a mean change in HbA1c from $6.8\% \pm 1.1\%$ to $5.5\% \pm 0.8\%$,

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Opinions expressed in these commentaries are those of the authors and not necessarily those of the American Academy of Pediatrics or its committees.

DOI: <https://doi.org/10.1542/peds.2018-0957>

Accepted for publication Apr 2, 2018

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

COMPANION PAPER: A companion to this article can be found online at www.pediatrics.org/cgi/doi/10.1542/peds.2017-3349.

To cite: Runge C and Lee JM. How Low Can You Go? Does Lower Carb Translate to Lower Glucose? *Pediatrics*. 2018;141(6):e20180957

but this also was a small study of just 10 participants with T1D, and both studies were performed only in adults.⁵

Reassuringly, the authors found relatively low rates of adverse events before and after the initiation of the VLCD for diabetes-related hospitalizations (8% before and 2% after), emergency encounters (8% and 3%), hypoglycemia requiring help from others (13% and 7%), and hypoglycemia requiring glucagon (7% and 4%); however, the rates may be susceptible to recall bias. Nonetheless, this is the first report of the frequency of adverse events and hospitalizations related to diabetes before and after the initiation of a VLCD because other studies have been limited by sample size or a lack of reporting.⁶

One key question that is most relevant for pediatricians is about the effects of a VLCD on growth. The authors assessed provider-reported height SDS at the time of diagnosis and after following a VLCD in 34 pediatric patients and found no correlation between height SDS and carbohydrate intake goal or diet duration. However, pubertal development could not be assessed, which limits an accurate interpretation of growth patterns.

The dramatic improvements in HbA1c, the presence of normal mean glucose readings with relatively low SDs, and the lack of significant excess adverse events reported by Lennerz et al² reveals that a VLCD, if sustained, could provide a novel method for improving glycemic control in patients with T1D. However, our enthusiasm must be tempered by limitations of the study, including the fact that it was performed in a subgroup of highly motivated patients who had well-controlled diabetes even before starting the diet (mean HbA1c of 7.15%), and the fact that detailed dietary records were not collected, making the carbohydrate sources

unknown. Furthermore, the VLCD may have been accompanied by changes in other aspects of diabetes management, such as maintaining stricter adherence to the insulin regimen, that could not be controlled for with the study design.

A future randomized controlled trial will need to be conducted to determine the efficacy of a VLCD for improving glycemic outcomes in T1D. The effect of both the amount and source of carbohydrates on glycemic control should be considered because studies on the association between carbohydrate sources and glycemic control have yielded inconsistent results.^{7–10} Furthermore, important outcomes to assess include not just HbA1c but also the percentage time in range, the frequency of diabetic ketoacidosis and hypoglycemia, BMI and linear growth outcomes (particularly in younger children), and cholesterol levels.

However, we must recognize that even if the therapy is determined to be efficacious, the uptake by patients and providers may be a barrier. The authors uniquely assessed the participants' satisfaction with their diabetes management and care team with a focus on the VLCD. Interestingly, 27% of participants reported not discussing their VLCD with their provider, and only approximately one-half of those who did agreed that their providers were supportive. This finding reveals the need for improved communication and shared decision-making between the patient, caregiver, and provider regarding the overall management of T1D and the need for greater dialogue within the T1D community regarding dietary standards of care.

ABBREVIATIONS

HbA1c: hemoglobin A1c
T1D: type 1 diabetes
VLCD: very low-carbohydrate diet

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Pediatrics originally published online May 7, 2018;

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