Nutritional approach in type 1 diabetes

From carbohydrate counting to technology-aware, cardiometabolic and psychologically safe nutrition care

Flavia Agata Cimini, MD, PhD
Sapienza Università di Roma

American Diabetes Association®

ADA Standards of Care 2026

Nutrition therapy goals for people with diabetes

1. Promote and support **healthful eating patterns**
2. Address **personal and cultural needs**
3. Preserve the **pleasure of eating**

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

From dietary restriction to individualized eating patterns

1989

American Diabetes Association.

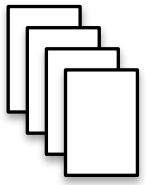
POSITION STATEMENT

Standards of Medical Care for Patients With Diabetes Mellitus

Then: nutrient-centered instructions

- Fixed exchanges, restrictions and avoidance
- Glycemic control often prioritized over pleasure, culture and sustainability

2026



American Diabetes Association.

5. Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes: Standards of Care in Diabetes—2026

Diabetes Care 2026;49(Suppl. 1):S89–S131 | https://doi.org/10.2337/dc26-S005

Now: food patterns + person-centered care

- Move away from isolated macronutrients toward foods and eating patterns
- No one-size-fits-all diet
- Meal planning reflects preferences, culture, literacy, numeracy, resources and goals

Start with assessment: the same algorithm will not fit everyone

BEFORE CHOOSING THE EDUCATION TOOL, DEFINE THE PERSON

Food literacy: Can the person identify carbohydrate sources and portions?

Numeracy: Can the person use ratios, correction factors and dose calculations safely?

Treatment plan: Fixed dosing, MDI, pump or hybrid closed-loop system?

Cardiometabolic risk: BMI trajectory, BP, lipids, MASLD risk, renal status

Psychological safety: Diabetes distress, fear of hypoglycemia, body image, disordered eating risk

Social background: Is the eating plan affordable, accessible and realistic?

The best nutrition algorithm is the one the person can understand, afford, sustain and safely use.

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

When should nutrition education be delivered?

R E P E A T E D L Y

AT DIAGNOSIS foundation: insulin-food matching, hypoglycemia prevention, cultural eating habits

ANNUALLY / NOT AT GOAL refresh skills, troubleshoot patterns, review weight and CVD risk

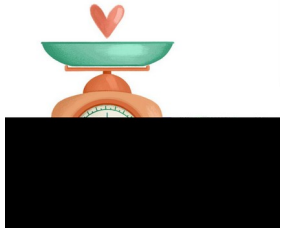
COMPLICATING FACTORS new comorbidities, psychosocial distress, food insecurity, functional barriers

TRANSITIONS school, work, pregnancy, adolescence, older age, new technology

Each technology upgrade is also a nutrition education opportunity

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

Carb counting: still core



THE LANCET
Diabetes & Endocrinology

Efficacy of carbohydrate counting in type 1 diabetes: a systematic review and meta-analysis

Kirstine J Bell, Alan W Barclay, Peter Petocz, Stephen Colagiuri, Jennie C Brand-Miller

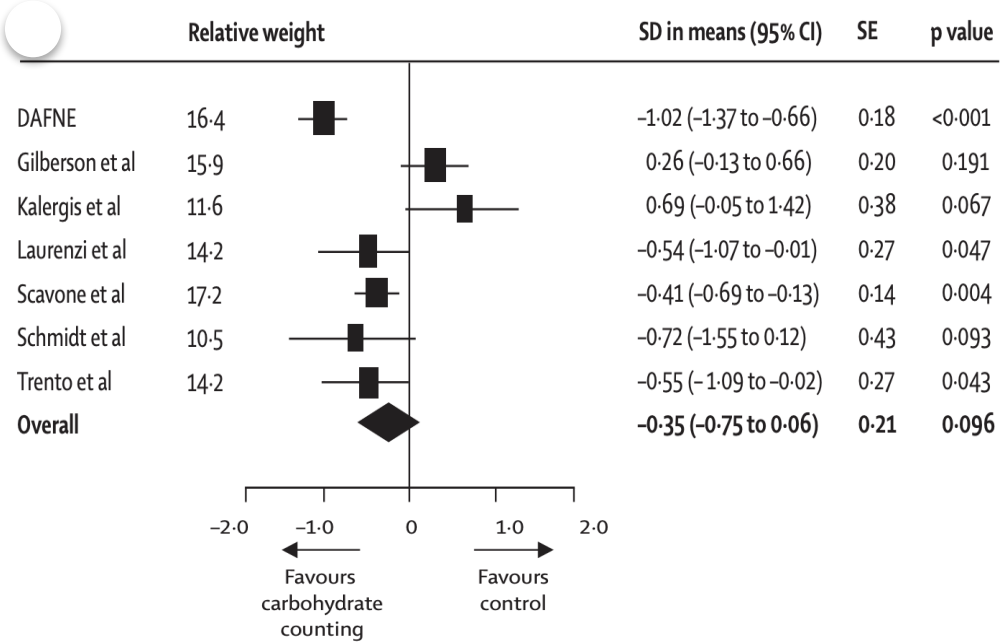


Figure 2: Meta-analysis of changes in HbA_{1c} after carbohydrate counting versus alternate advice or usual care in type 1 diabetes

Bell KJ et al. Lancet Diabetes Endocrinol. 2014

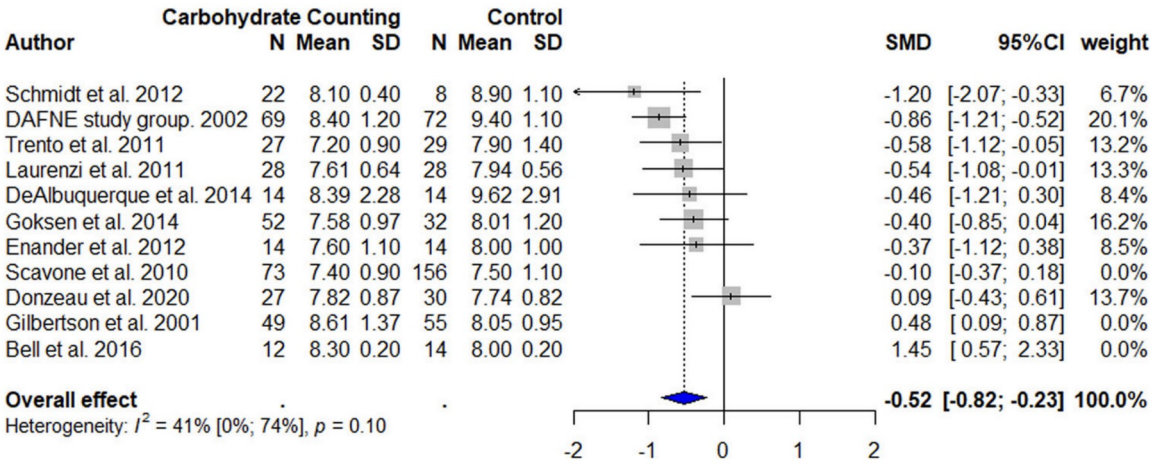
Received: 24 September 2021 | Accepted: 24 March 2022
DOI: 10.1111/jhn.13017

CHRONIC DISEASE

JHND BDA

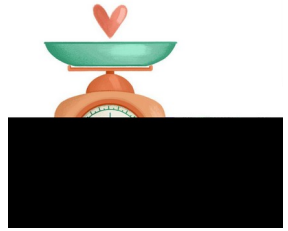
Efficacy and safety of carbohydrate counting versus other forms of dietary advice in patients with type 1 diabetes mellitus: a systematic review and meta-analysis of randomised clinical trials

Carlos E. Builes-Montaño[1,2] | Natalia A. Ortiz-Cano[3] | Alex Ramirez-Rincón[4,5] | Natalia A. Rojas-Henao[2,6]



Carlos E. Builes-Montano et al. JHND 2022

… but no longer the whole story



What it does well
Links carbohydrate amount to prandial insulin needs, flexible eating and insulin-to-carbohydrate ratios.

What it misses
Food matrix, fiber, fat/protein effects, timing, portion bias and delayed postprandial hyperglycemia

What it requires
Numeracy, food literacy, label skills, portion estimation and willingness to engage without obsession

Carbohydrate counting remains valuable, **but its intensity should be stratified** by skills, safety, technology and preference

ADA 2026: From carbohydrate grams to the whole plate

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CORE NUTRITION PRINCIPLES RELEVANT TO T1D

- **Eating patterns should emphasize key nutrition principles, including nonstarchy vegetables, whole fruits, legumes, lean proteins, whole grains, nuts and seeds, and low-fat dairy or nondairy alternatives, and should minimize consumption of red meat, sugar-sweetened beverages, sweets, refined grains, processed and ultraprocessed foods.**
- Counsel to limit sodium consumption to <2,300 mg/day, as clinically appropriate. The best way to achieve this is through limiting consumption of processed foods.
- Encourage to consume **water** over other beverages.
- **Emphasize minimally processed, nutrient-dense, high-fiber sources of carbohydrate**, with at least 14 g fiber per 1,000 kcal.
- **Provide education on the glycemic impact of carbohydrate, fat, and protein**
- Incorporate more plant-based protein sources, such as nuts, seeds, and legumes
- Consider an eating plan emphasizing elements of a **Mediterranean eating pattern**
- Limit intake of foods high in saturated fat

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

NUTRITION BEHAVIORS TO ENCOURAGE

Meal planning

Plan meals for the week. Grocery shop using a list. Cook on a day off so there are ready-to-eat and ready-to-reheat homemade meals available in the fridge or freezer.

Shared preparation

Include family or roommates in meal preparation. Share responsibilities for grocery shopping and cooking, and use time off for meal preparation in advance when possible.

The plate method

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

The Mediterranean pattern is a positive, sustainable framework for cardiometabolic prevention in T1D.

Observational signal: higher Mediterranean adherence associated with better HbA1c/TIR

Interventional signal: MedDiet intervention improved diet quality and TIR

Clinical logic: high fiber, unsaturated fats, legumes, nuts, fish and low UPF reduce cardiometabolic burden.

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

Technology-aware nutrition: flexibility and pattern recognition

Technology can support flexibility
Less fear around variability, more flexible timing and portions, immediate feedback on new foods, safer experimentation with mixed meals

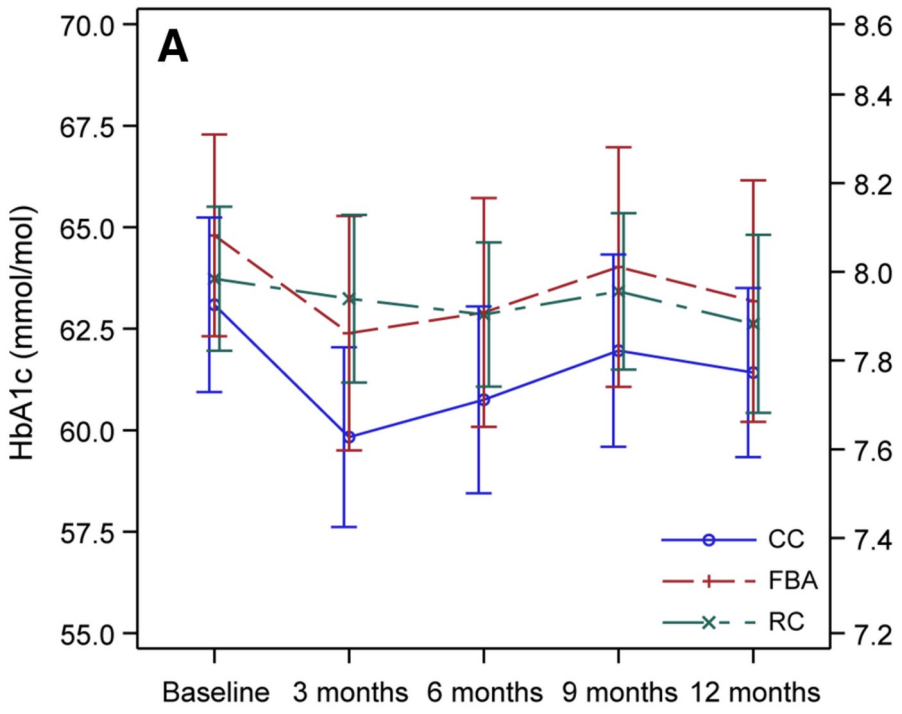
CGM makes meals interpretable
- **Rapid spike:** high-GI/refined carbohydrates, missed prebolus, liquid sugar
- **Late rise:** high-fat/high-protein meal, grazing, under-bolused mixed meal
- **Nocturnal drift:** dinner composition, alcohol, late correction, basal/AID response
- **Frequent lows:** insulin timing mismatch, overcorrection, fear-driven overtreatment

From pattern recognition to structured bolus adjustment
Meal composition → insulin strategy → CGM feedback → safe iteration

AID reduces precision burden, not education needs
Meal announcement, approximate carbohydrate estimation, insulin timing and understanding fat/protein effects remain clinically relevant.

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

Food-based education: benefits beyond HbA1c



BMJ Open Diabetes Research & Care

Effects of nutrition education using a food-based approach, carbohydrate counting or routine care in type 1 diabetes: 12 months prospective randomized trial

Sofia Sterner Isaksson [1,2] Margareta Bensow Bacos,[3] Björn Eliasson,[1] Eva Thors Adolfsson,[4] Araz Rawshani,[1] Ulf Lindblad,[5] Johan Jendle,[6] Agneta Berglund,[3] Marcus Lind,[1,2] Mette Axelsen[3]

FBA, CC and RC did not differ significantly in HbA1c

Compared with CC and RC, FBA improved food choices, quality of life and cardiovascular risk profile

FBA showed more stable outcomes over time, with less fluctuation

Sterner Isaksson S et al. BMJ Open Diabetes Res Care. 2021

Simplified meal announcement in AID

Diabetes Care
American Diabetes Association

A Randomized Crossover Trial to Compare Automated Insulin Delivery (the Artificial Pancreas) With Carbohydrate Counting or Simplified Qualitative Meal-Size Estimation in Type 1 Diabetes

Ahmad Haidar, Laurent Legault, Marie Raffray, Nikita Gouchie-Provencher, Adnan Jafar, Marie Devaux, Milad Ghanbari, and Rémi Rabasa-Lhoret

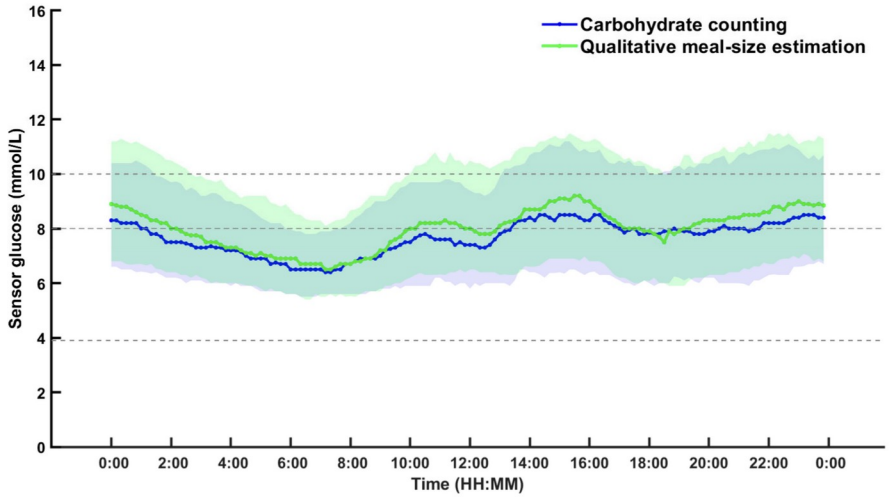


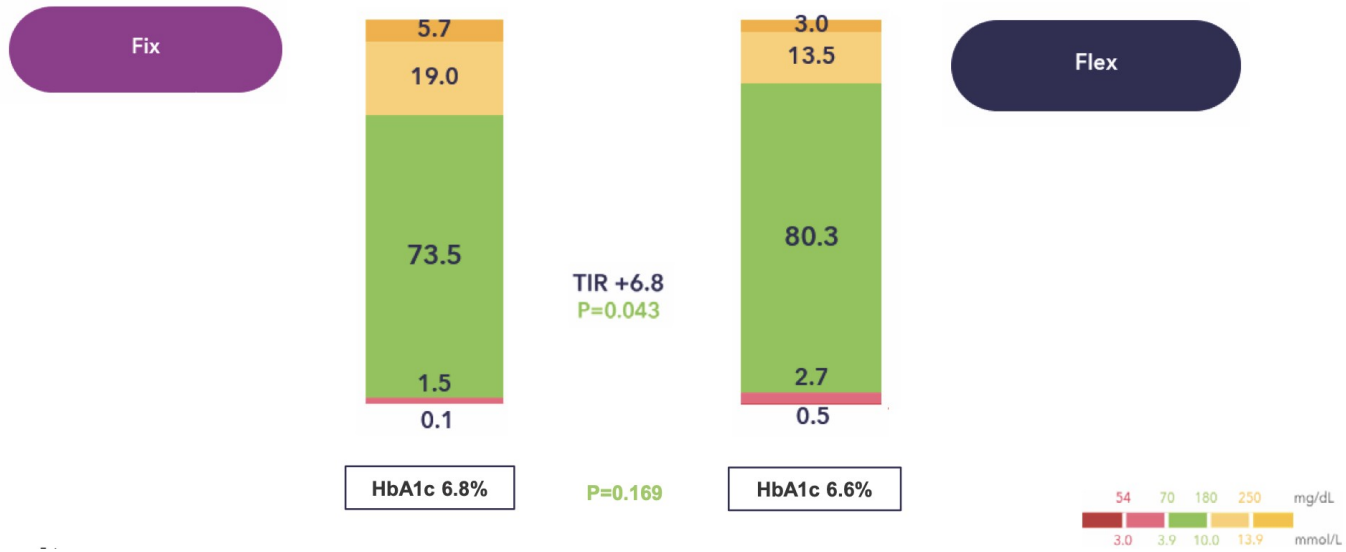
Figure 1—The median (IQR) profiles of individual mean glucose levels during 3 weeks of automated insulin delivery with CHO counting (blue; *n* = 30) and the qualitative meal-size estimation strategy (green; *n* = 30). At each time point, mean values were calculated for each participant, and then the medians (IQR) were calculated across participants.

TIR: CC **74.1 ± 10.0%** vs SQMSE **70.5 ± 11.2%**
TBR: CC/SQMSE **<1.6%**.

Haidar A et al. Diabetes Care. 2023

Simplified Meal Announcement Versus Precise Carbohydrate Counting in Adolescents With Type 1 Diabetes Using the MiniMed 780G Advanced Hybrid Closed Loop System: A Randomized Controlled Trial Comparing Glucose Control

Goran Petrovski, Judith Campbell, Maheen Pasha, Emma Day, Khalid Hussain, Amel Khalifa, and Tim van den Heuvel



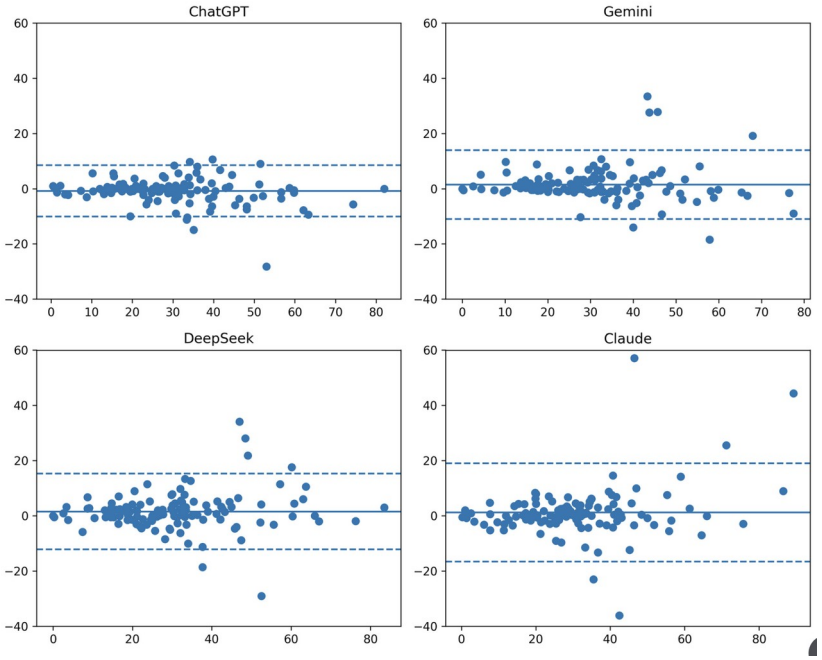
Goran Petrovski et al. Diabetes Care 2023

AI may support carbohydrate estimation

ORIGINAL ARTICLE OPEN ACCESS

Accuracy of ChatGPT, Gemini, Claude and DeepSeek in Carbohydrate Counting

Luca Zagaroli[1] | Nicholas Caione[2] | Sabina Zara[3] | Federica Guerra[1] | Antonella Zugaro[4] | Marco Giorgio Baroni[5,6] | Maria Laura Iezzi[1] | Maurizio Delvecchio[2]



Nutrition and Disease

Evaluating ChatGPT for Carbohydrate Counting Accuracy in Diabetes Management: A Precision Health Approach

Serkan Aslan [1], Saniye Sözlü [2]

AI tools may serve as valuable tools in carbohydrate counting for patients when appropriate description is provided, with a precision comparable to clinicians' estimations. ChatGPT is the one that performs best in carbohydrate counting compared to the clinicians among general-purpose AI models. The other models tend to slightly underestimate the clinicians' reference with wider dispersion of errors, but the errors appear to be within a clinically acceptable limit.

- **Image-based tools and AI systems may reduce cognitive burden in meal estimation.**
- Strengths: rapid feedback, training support, lower numeracy demand.
- Limitations: portion size, mixed dishes, cultural foods, hidden fats, trust and overreliance.

New and old vulnerabilities

Overweight and obesity in T1D: an increasing global burden

diabetesresearchandclinicalpractice 229 (2025) 112899

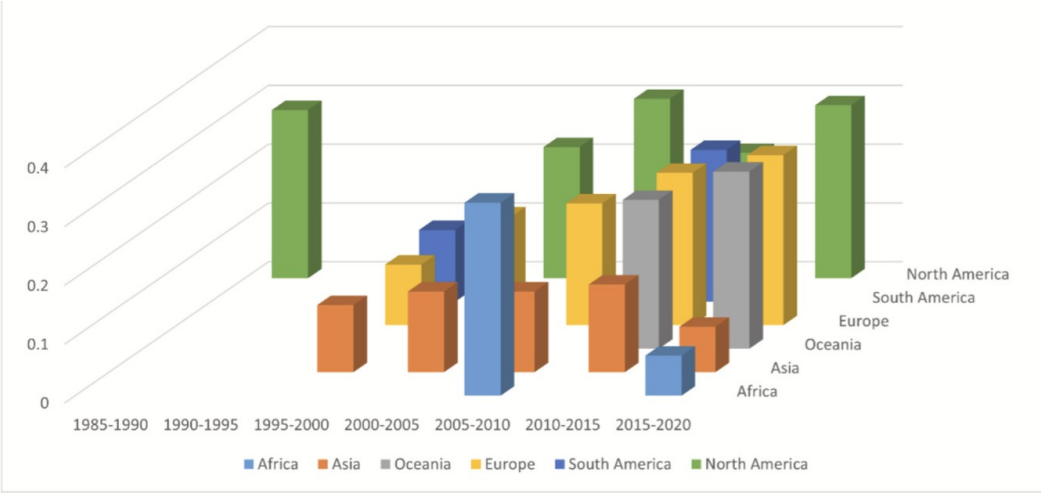
Contents lists available at ScienceDirect

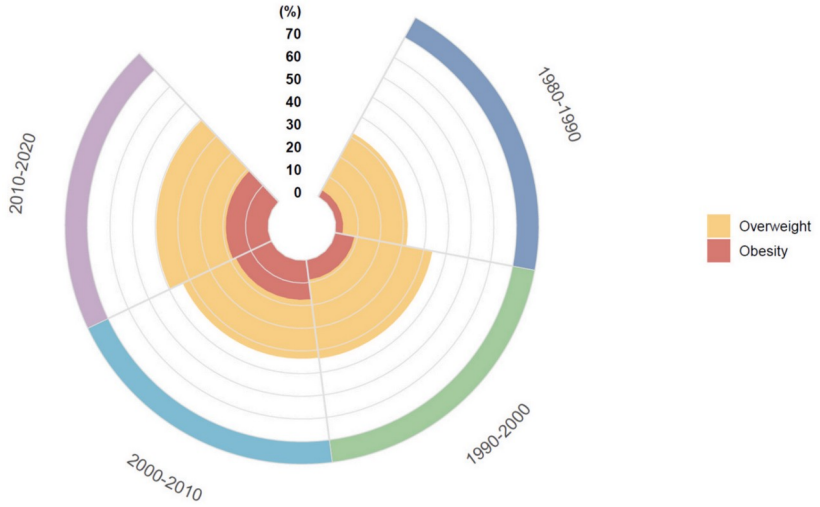
Diabetes Research and Clinical Practice

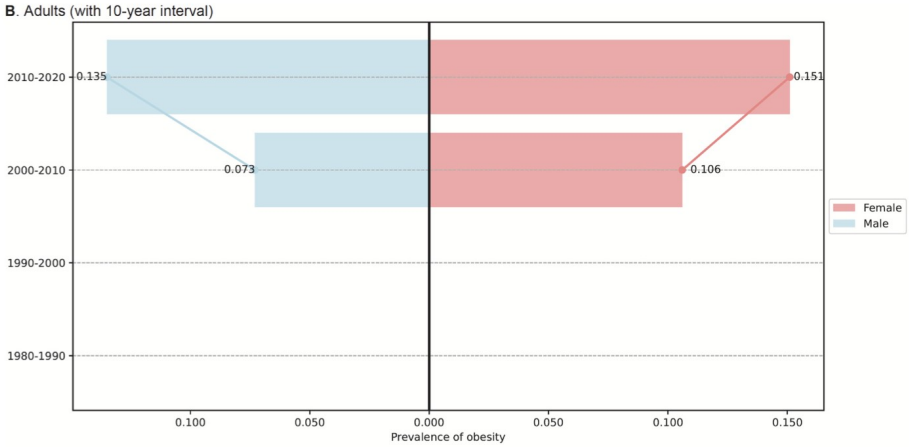
journal homepage: www.journals.elsevier.com/diabetes-research-and-clinical-practice

Regional, age-specific and sex-specific trends in the prevalence of overweight or obesity in type 1 diabetes from 1980 to 2020: a meta-analysis of 78 observational studies with 650,265 participants

Yuchen Guo [1], Chu Lin [1], Xiaoling Cai [2,*], Han Wu, Jingya Yan, Zonglin Li, Ruoyang Jiao, Shuzhen Bai, Wenjia Yang, Fang Lv, Linong Ji [**]







Guo Y et al. Diabetes Res Clin Pract. 2025

Trends in baseline HbA1c and body-mass index in randomised trials of people with type 1 diabetes from 1993 to 2025: an IMI2 SOPHIA systematic review and meta-analysis

Amar D. E. van Laar,[a,m] Laura Gallardo-Nuell,[b,c,d,l,m] Sofia Pazmino Lucio,[a] Margaretha M. Visser,[a,e] Ann Mertens,[a,e] Roman Vangoitsenhoven,[a,e] Pieter Gillard,[a,e] Ebaa Al Ozairi,[f] Carel W. Le Roux,[g,h] Jonathan Rosen,[i] Carmen Hurtado del Pozo,[i] Yenny Leal,[b,c,d] José Manuel Fernández-Real,[b,c,d,j] Chantal Mathieu,[a,e] Nele Steenackers,[a,k,m] and Bart Van der Schueren[a,e,m,*]

Time period	Weighted mean BMI (CI 95)	Weighted mean HbA1c (CI 95)
1993–2002	25.0 (24.7–25.3)	7.9 (7.6–8.2)
2003–2012	25.3 (25.0–25.5)	8.2 (8.0–8.3)
2013–2022	27.1 (26.7–27.5)	8.0 (7.9–8.1)
2016–2025	26.9 (26.4–27.3)	7.9 (7.8–8.0)

The first decade starts in 1993 when the first study was included, two 10-year periods follow. The last decade is counted backwards from the inclusion of the last study included. Data are weighted means and 95% confidence intervals.

Table 2: **Weighted mean values for baseline BMI and HbA1c across the study period, 1993–2025.**

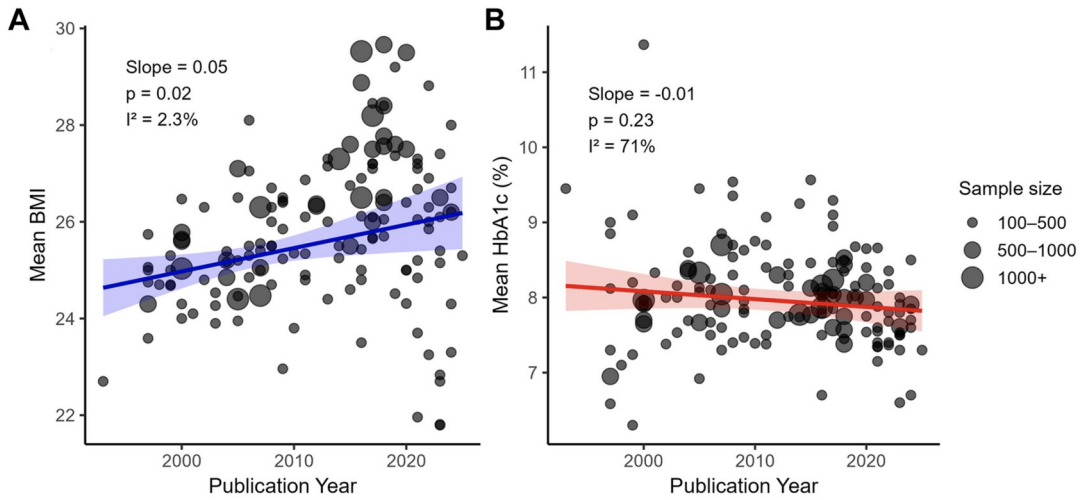


Fig. 2: **Trends for baseline BMI (2A) and HbA1c (2B) in clinical trials (published between 1993 and 2025) involving individuals living with type 1 diabetes.** The size of dots corresponds with the number of participants in the study. A trend with a p-value of <0.05 was considered to be significant.

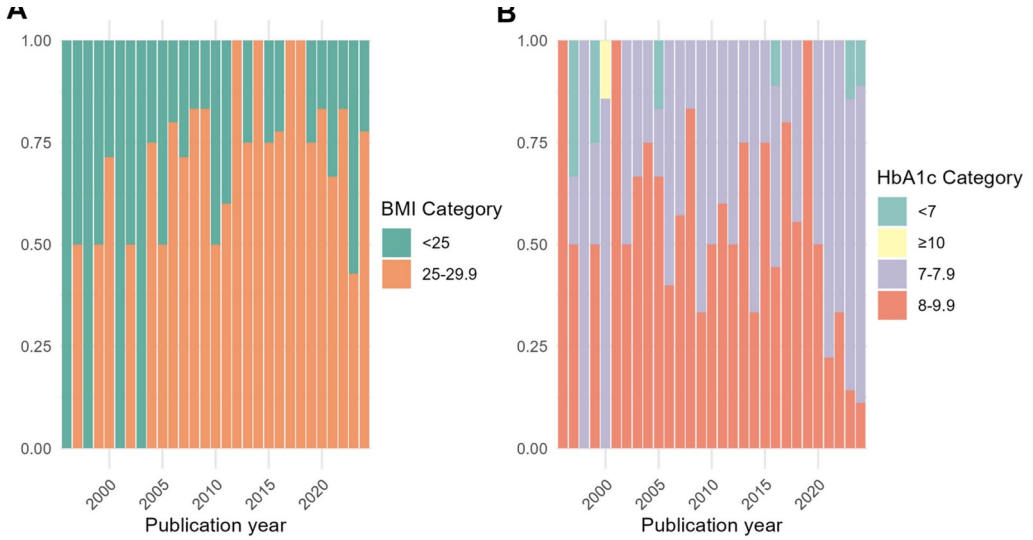


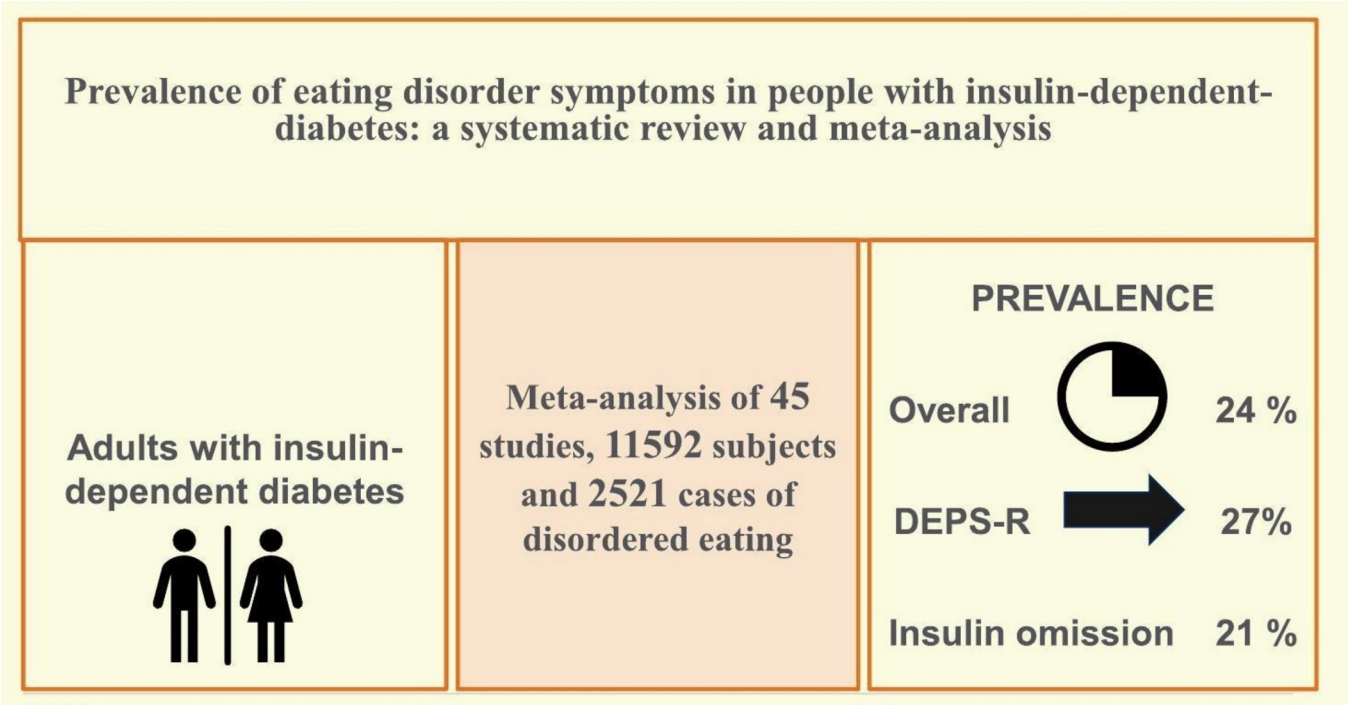
Fig. 4: **Changes in the proportion of studies with an average BMI of at least 25 kg/m² (4A) or defined HbA1c ranges (4B) over time.**

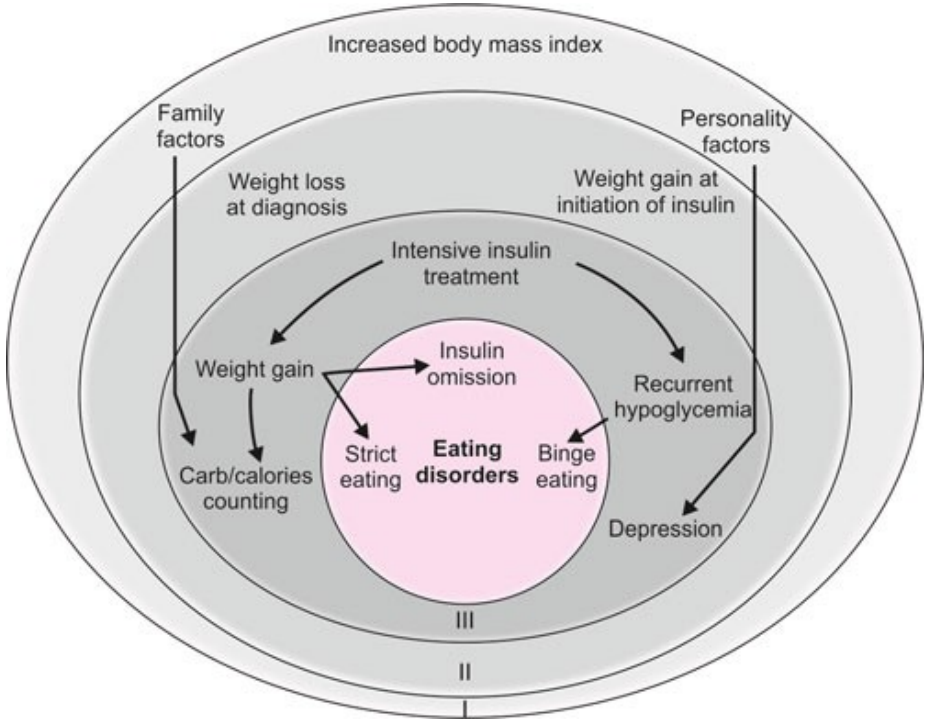
Eating disorders in T1D: common, dangerous and often missed

↑ risk

Prevalence of eating disorder symptoms in people with insulin-dependent-diabetes: A systematic review and meta-analysis

Pia E. Niemelä [a,1], Hanna A. Leppänen [a,*,1], Ari Voutilainen [b], Essi M. Möykkynen [a], Kirsi A. Virtanen [c], Anu A. Ruusunen [b,d,e], Reeta M. Rintamäki [a]





ORIGINAL ARTICLE

International Journal of EATING DISORDERS WILEY

Prevalence of disordered eating behaviors in adolescents with type 1 diabetes: Results of multicenter Italian nationwide study

Alda Troncone PhD[1] | Gaetana Affuso PhD[1] | Crescenzo Cascella PsyD[1] | Antonietta Chianese PhD[1] | Barbara Pizzini PhD[1] | Angela Zanfardino MD[2] | Dario Iafusco MD[2] | Diabetes Study Group of Italian Society of Paediatric Endocrinology and Diabetology

[1]Department of Psychology, University of Campania "Luigi Vanvitelli", Caserta, Italy

[2]Department of the Woman, of the Child and of the General and Specialized Surgery, University of Campania "Luigi Vanvitelli", Naples, Italy

Abstract

Objective: To assess the prevalence of disordered eating behaviors (DEBs) in a large sample of Italian adolescents with type 1 diabetes and to explore potential demographic, clinical, and psychological differences (understood as emotional and behavioral problems) among adolescents with and without DEBs.

Method: Adolescents (11–19 years) with type 1 diabetes completed the Diabetes Eating Problems Survey-revised (DEPS-r) and the Youth Self Report (YSR). Demographic and clinical data were also collected.

Results: Of 690 adolescents with type 1 diabetes (mean age 14.97 ± 1.81, $n = 337$ girls) assessed in this study, 28.1% (21% boys, 35% girls) were DEPS-r positive (score ≥ 20). Girls had higher DEPS-r total scores ($p < .0001$, $d = .42$) than boys, although no age differences were found in mean DEPS-r total scores ($p = .961$). In both genders, adolescents with DEBs had significantly higher zBMI ($p < .0001$, $d = .52$) and HbA1c values ($p < .0001$, $d = .54$) and showed more emotional and behavioral problems (both as internalizing and externalizing problems) than those without DEBs (all $p < .0001$). These differences were largely confirmed in all age groups. Adolescents reporting insulin misuse had higher HbA1c values ($p = .001$, $d = .26$), higher DEPS-r mean scores ($p < .0001$, $d = 1.07$), and greater psychological problems (all $p < .001$) than those who did not.

Discussion: DEBs are prevalent among adolescents with type 1 diabetes, and those with eating problems showed adverse clinical and psychological conditions. Routine screening for DEBs and of general psychological condition should be a fundamental part of diabetes care, especially during adolescence.

Troncone A et al. Int J Eat Disord. 2022

Diabetologia (2025) 68:766–777
https://doi.org/10.1007/s00125-024-06346-7

ARTICLE

Eating disorders among people with and without type 1 diabetes: incidence and treatment in a nationwide population-based cohort

Leon Hirvelä[1] · Jari Haukka[1] · Anna Keski-Rahkonen[1] · Pyry N. Sipilä[1]

In conclusion, we found over twofold higher incidence of eating disorders in individuals with type 1 diabetes compared with diabetes-free control individuals. The use of psychotropic medications among eating disorder patients was substantial and did not differ among those with vs without type 1 diabetes. However, those with type 1 diabetes received less outpatient hospital treatment for their eating disorders than those without diabetes. Our findings emphasise the need to reduce this discrepancy in treatment intensity in order to alleviate the burden of this severe dual condition of co-occurring eating disorder and type 1 diabetes.

Hirvelä L et al. Diabetologia. 2025

T1D eating disorders: a recognized gap in care

BBC NEWS

New Parliamentary inquiry into type 1 diabetes and eating disorders launched

Sir George Howarth MP and Rt. Hon Theresa May MP have launched a new inquiry into eating disorders in type 1 diabetes, also known as T1DE, supported by JDRF as the secretariat.

The parliamentary inquiry, funded with support from JDRF International, identified several systemic gaps and barriers that fail to provide effective support and care for people affected by T1DE (type 1 diabetes specific eating disorders). This includes gaps in diagnostic criteria and terminology for T1DE, the effect of stigma, limited research and evidence in this area, lack of knowledge and training of healthcare professionals, and lack of funding and access to mental health providers and eating disorder support services. There are clearly many areas that must be addressed to improve the experiences of people who are affected by T1DE.

A clear finding from the report is the need for integrated mental health support into diabetes care, with a recommendation to introduce mental health checks along with the existing physical health checks and screening during annual diabetes care appointments, and a need for mental health providers to have training on diabetes and T1DE. People living with T1DE often receive mixed messages and advice from different care providers with conflicting care plans. This latter finding suggests a need for greater communication, collaboration, and integration of different health services within health systems.

- **System gaps in diagnosis, terminology and access to specialist support**
- **Need for diabetes-specific screening during routine care**
- **Need for integrated mental health care and trained professionals**
- **Conflicting messages from different providers can increase burden**

What can we do?

- Screen explicitly and nonjudgmentally for disordered eating and insulin omission
- Use diabetes-specific tools when appropriate, such as DEPS-R
- Do not focus only on A1C: look for recurrent DKA, weight preoccupation, fear of hypoglycemia and rigid tracking
- Avoid intensive carb counting or weight monitoring when they reinforce pathology
- Prioritize trust, nutrition adequacy, DKA prevention and severe hypoglycemia prevention
- Work with a psychologist experienced in diabetes and eating disorders

ADA Standards of Care in Diabetes 2026. *Diabetes Care* 2026; 49 (Supplement_1): S89–S131.

Take-home messages

- Technology has changed nutrition care in T1D, but it has not made nutrition education obsolete. It has made it more targeted, safer and more personalized.
- Carbohydrate counting remains a core skill, but not every person needs the same level of precision.
- The whole plate matters: fat, protein, fiber, food processing, alcohol and meal timing shape glucose patterns and cardiometabolic risk.
- Modern T1D nutrition must be cardiometabolic and psychologically safe: screen proactively for weight gain, insulin resistance and disordered eating.
- The best nutrition plan is the least burdensome plan that achieves glycemic safety, protects long-term health and preserves the pleasure of eating.

Nutrition care in T1D should be precise enough for safety, flexible enough for life and broad enough for long-term health.