Personalised Nutrition and Continuous Blood Glucose Monitoring

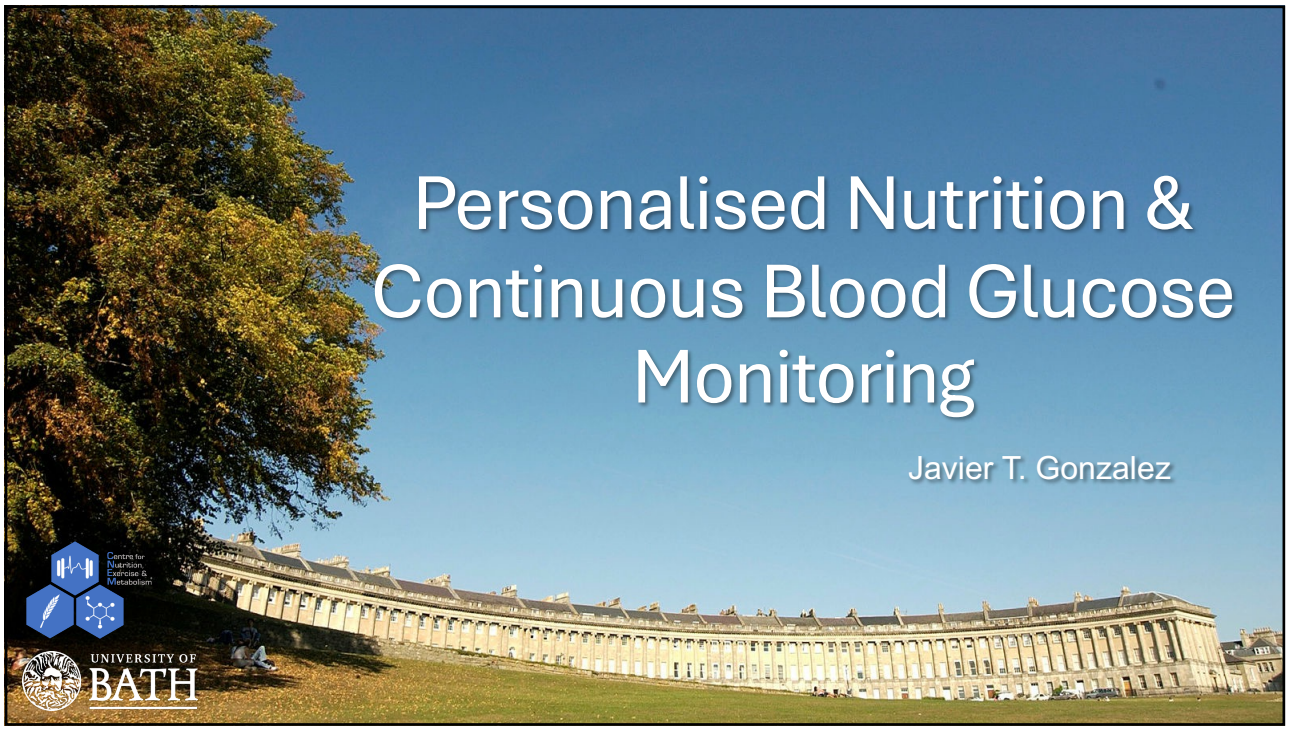
Professor Javier Gonzalez

14:30 – 15:15



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Affiliations and Disclosures

Affiliations
Department for Health, University of Bath, Bath, UK

Disclosures
Received research funding from BBSRC, MRC, British Heart Foundation, Clasado Biosciences, Lucozade Ribena Suntory, ARLA Foods Ingredients, Cosun Nutrition Center, Innocent Drinks and the Fruit Juice Science Centre; is a scientific advisory board member to ZOE; and has completed paid consultancy for 6d Sports Nutrition, Science in Sport, The Dairy Council, PepsiCo, Violicom Medical, Tour Racing Ltd., and SVGC.

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Other potential biases



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Acknowledgements

Students
Colleagues
Collaborators
Funders
Participants



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Overview

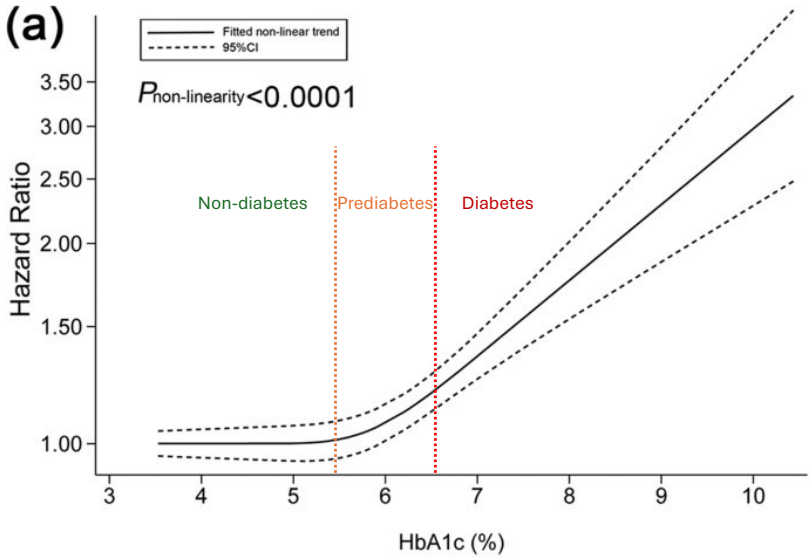
Importance of blood glucose in the GLP-1RA era

Pros and cons of continuous glucose monitoring

Rationale and approach to personalised nutrition

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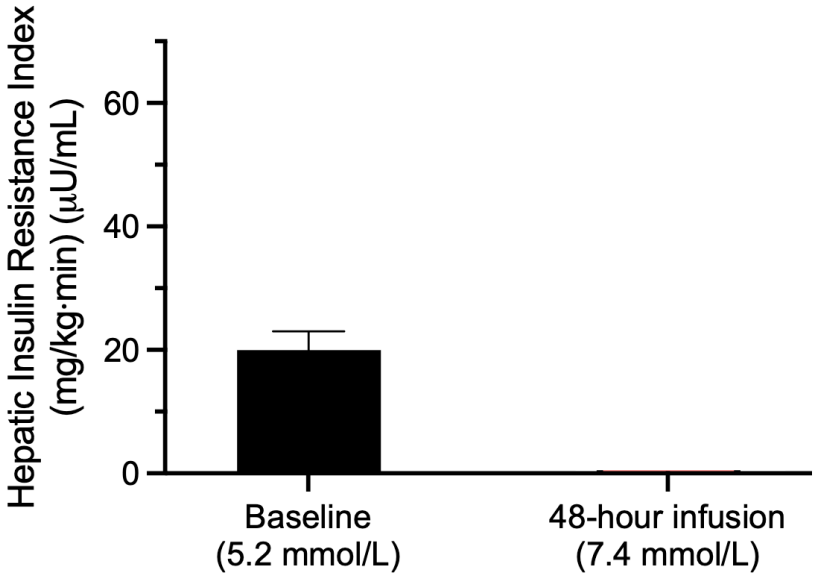
Why should we care about blood sugar in non-diabetes?



Zhong, *et al.* HbA_{1c} and Risks of All-Cause and Cause-Specific Death in Subjects without Known Diabetes: A Dose-Response Meta-Analysis of Prospective Cohort Studies. *Sci Rep 2016;* **6**, 24071.

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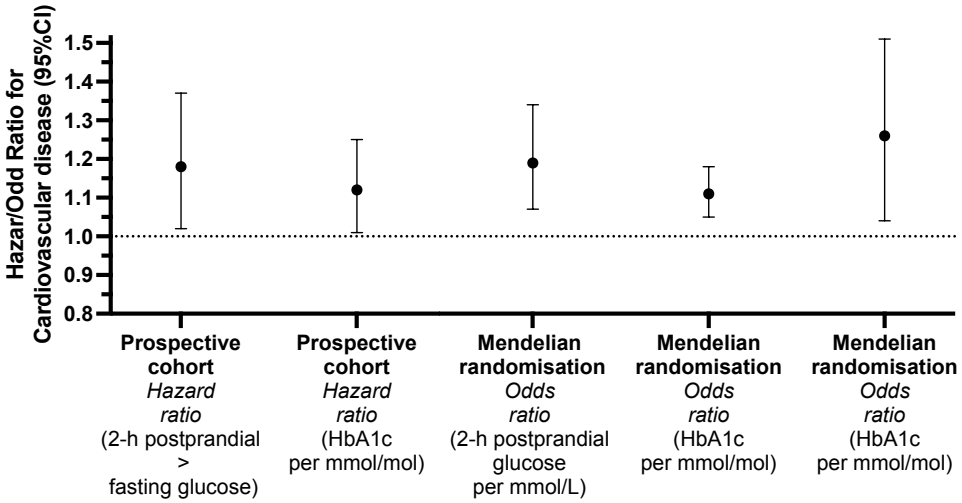
Modest increases in glucose can reduce hepatic insulin sensitivity



Tripathy et al., Mild Physiologic Hyperglycemia Induces Hepatic Insulin Resistance in Healthy Normal Glucose-Tolerant Participants, *J Clin Endocrinol Metab*, 2019; 104 (7) 2842–2850.

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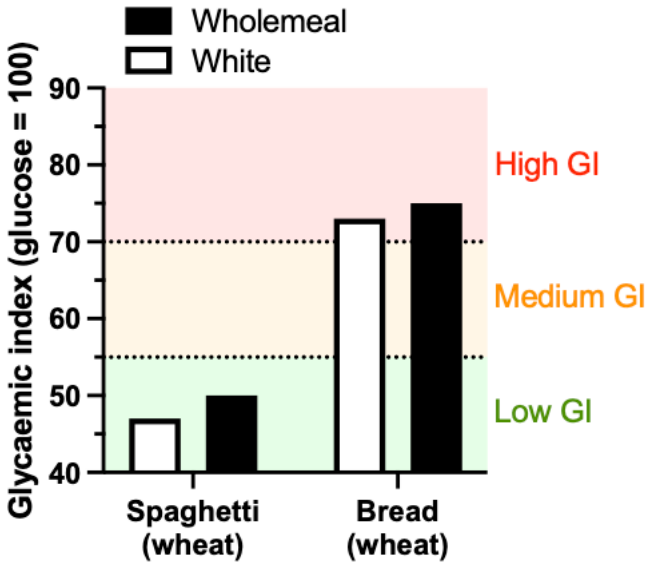
Glucose is associated with disease even in the non-diabetic range



Ning, et al.,*Diabetes Care*,2010.33(10):p.2211-2216; Ning, et al.,*Cardiovascular Diabetology*,2012.11:p.1-7; Liu, et al.,*Genes*,2021.12(10):p.1644; Yuan, et al.,*Diabetes*,2022.71(10):p.2222-2232; Burgess, et al.,*Diabetologia*,2021.64(4):p.845-849.

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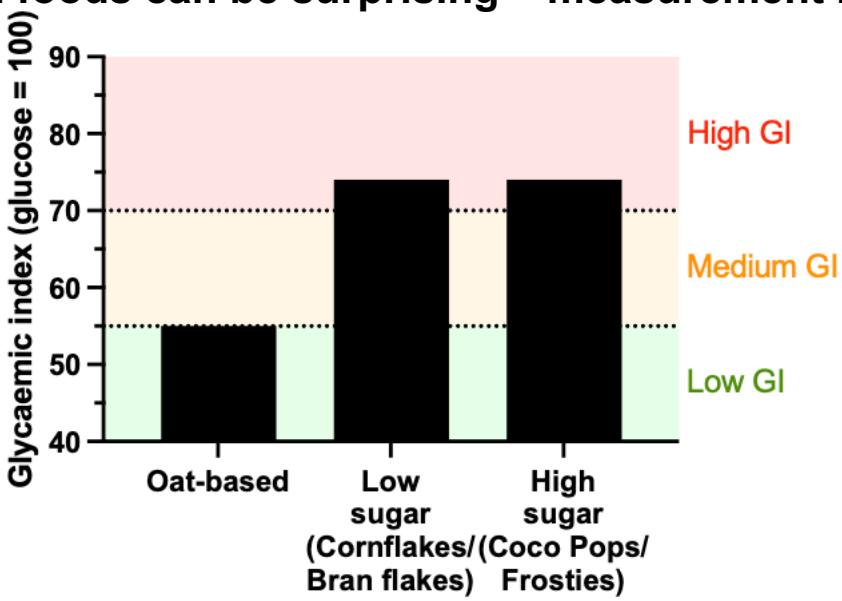
We can chose foods that lower glycaemia



Atkinson et al., International tables of glycemic index and glycemic load values 2021: a systematic review. *Am J Clin Nutr* 2021; 114(5):1625-1632.

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Low GI foods can be surprising – measurement is key

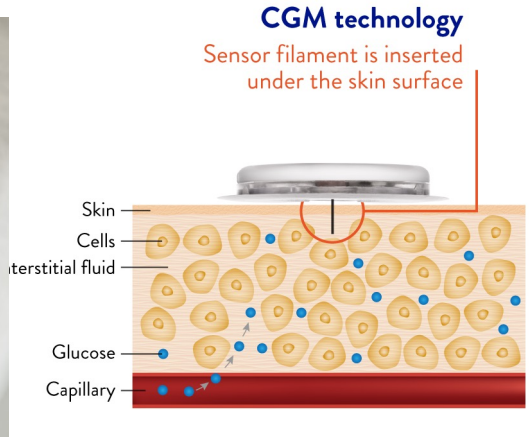


Atkinson et al., International tables of glycemic index and glycemic load values 2021: a systematic review. *Am J Clin Nutr* 2021; 114(5):1625-1632.

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Several methods exist for measuring blood glucose





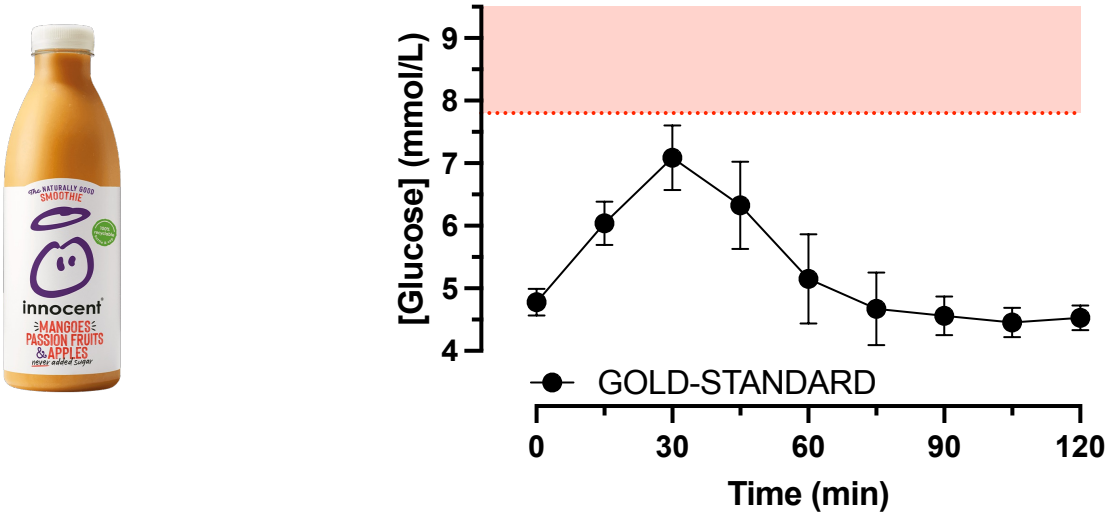
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Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr.* 2025;121(5):1025-1034.

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Blood glucose responses to the commercial product remain in a "normal" range

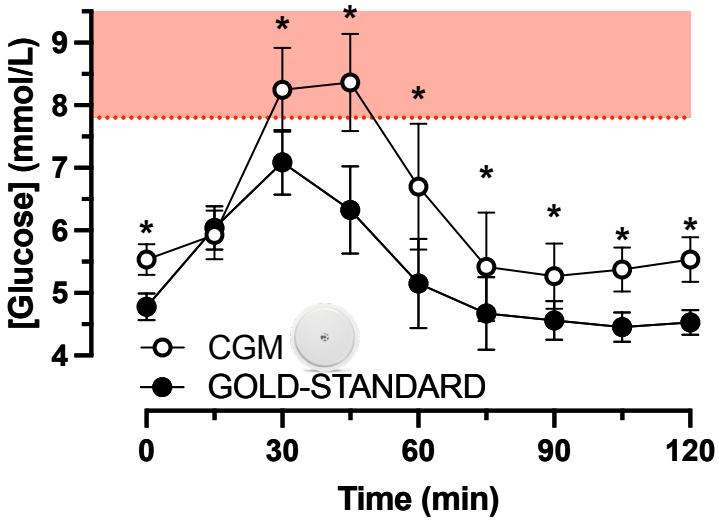


Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr.* 2025;121(5):1025-1034.

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Continuous glucose monitors overestimated blood glucose responses

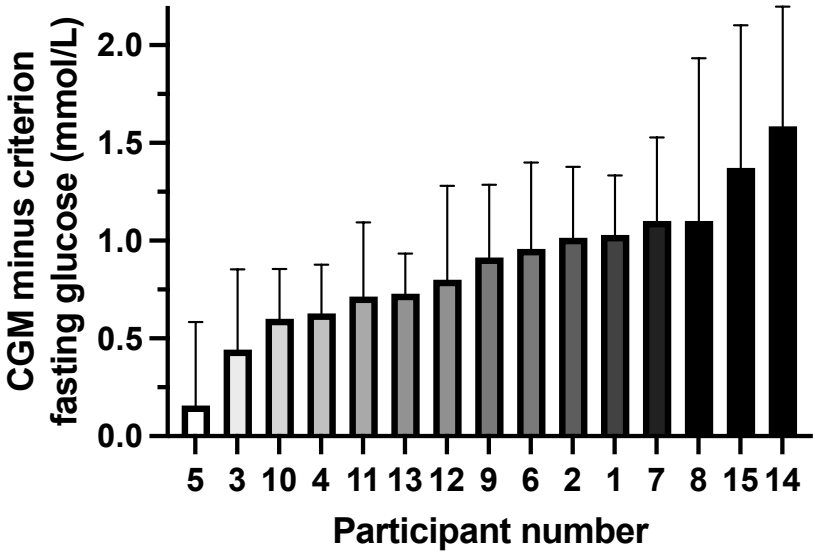




Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr.* 2025:121(5):1025-1034.

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There were differences between people in the error of CGM

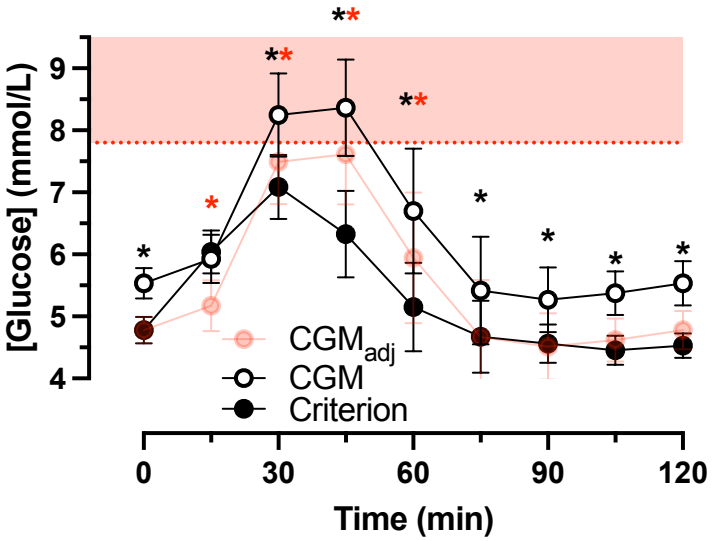


Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr.* 2025:121(5):1025-1034.

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Adjusting CGM based on the fasting difference was insufficient

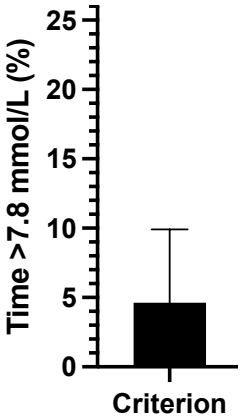




Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr.* 2025:121(5):1025-1034.

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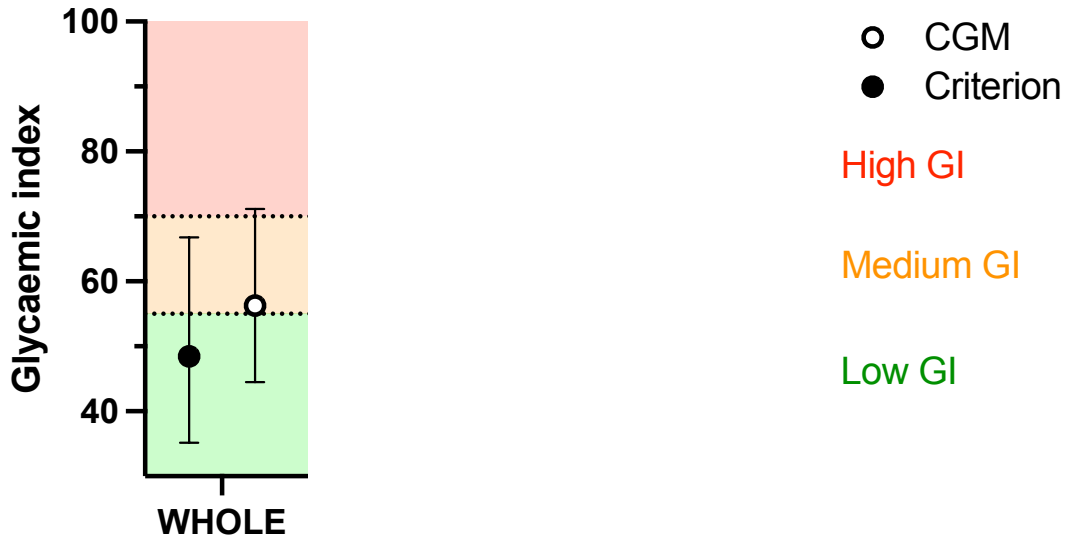
CGM substantially overestimated ”hyperglycaemia”



Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr.* 2025:121(5):1025-1034.

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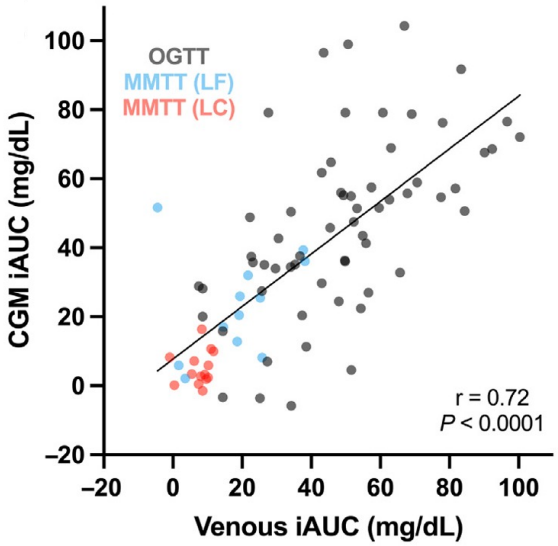
CGMs can misclassify the glycaemic index



Hutchins et al., Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual - a randomized crossover trial. *Am J Clin Nutr*. 2025;121(5):1025-1034.

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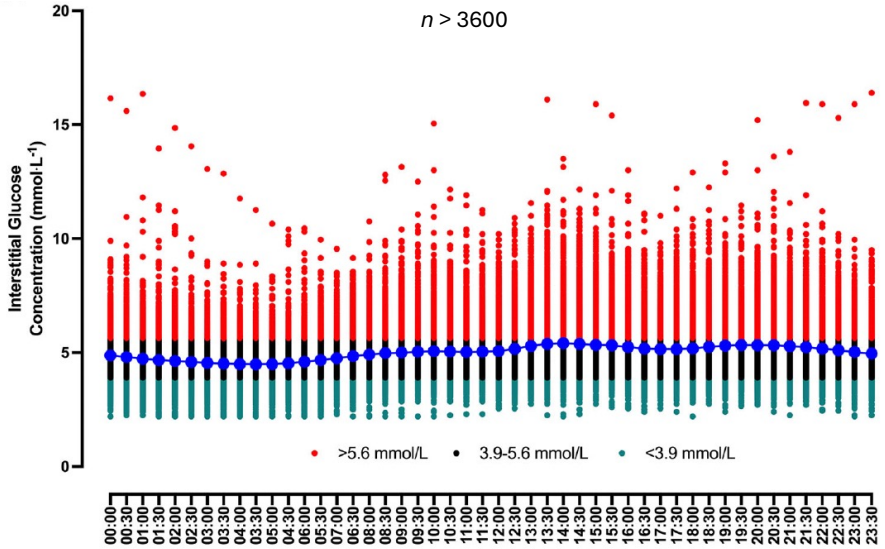
Independent observations of CGM error



Hengist et al., Imprecision nutrition? Intraindividual variability of glucose responses to duplicate presented meals in adults without diabetes. *Am J Clin Nutr*. 2025;121(1):74-82.

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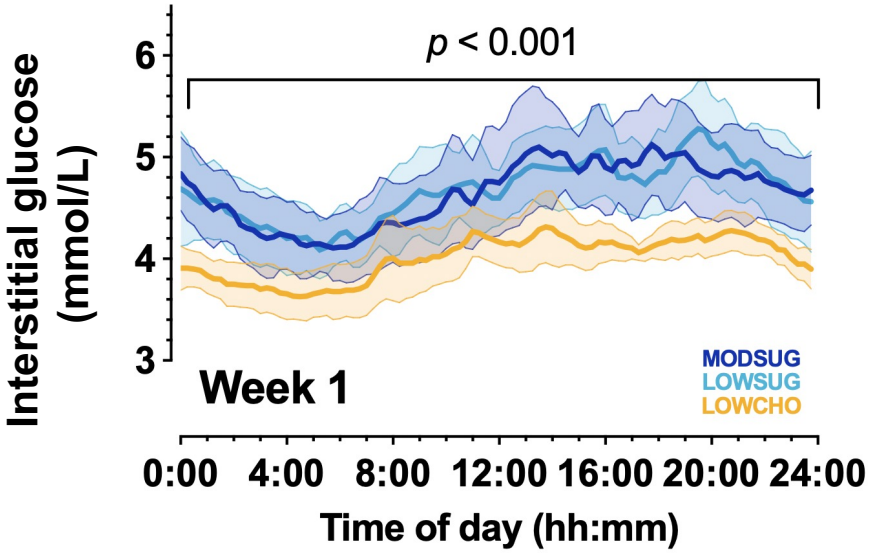
CGM facilitates large datasets on glycaemia



Bermingham *et al.,* Associations of continuous glucose monitor derived time in range and glycaemic variability with diet lifestyle and demographics. *Nat Commun* 2026; **17**, 4496..

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CGM can identify broad patterns

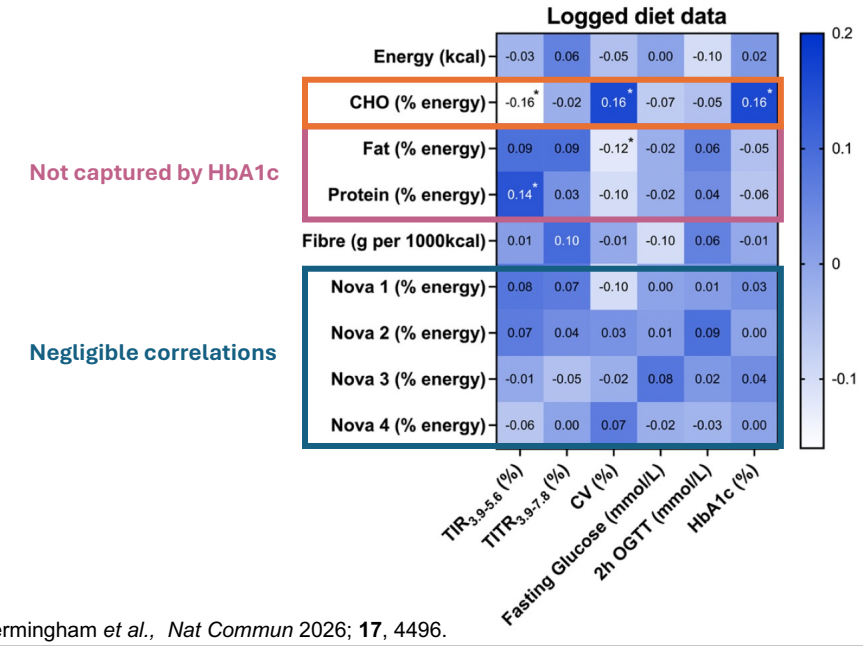




Hengist et al., Ketogenic diet but not free-sugar restriction alters glucose tolerance, lipid metabolism, peripheral tissue phenotype, and gut microbiome: RCT. *Cell Rep Med*. 2024 ; 20;5(8):101667.

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CGM can identify associations not captured by HbA1c



Bermingham *et al.*, *Nat Commun* 2026; **17**, 4496.

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Interim Summary

Blood glucose is important for health (aside from diabetes)

CGMs are useful but have limitations that need consideration

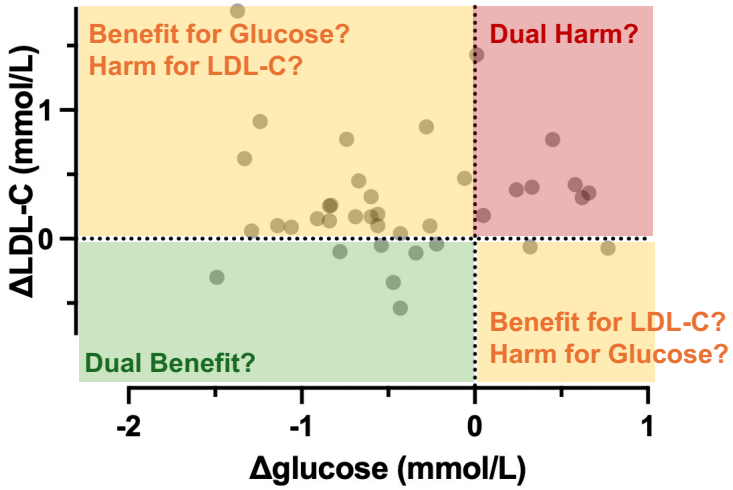
CGMs appear better for broad patterns than specific foods/meals

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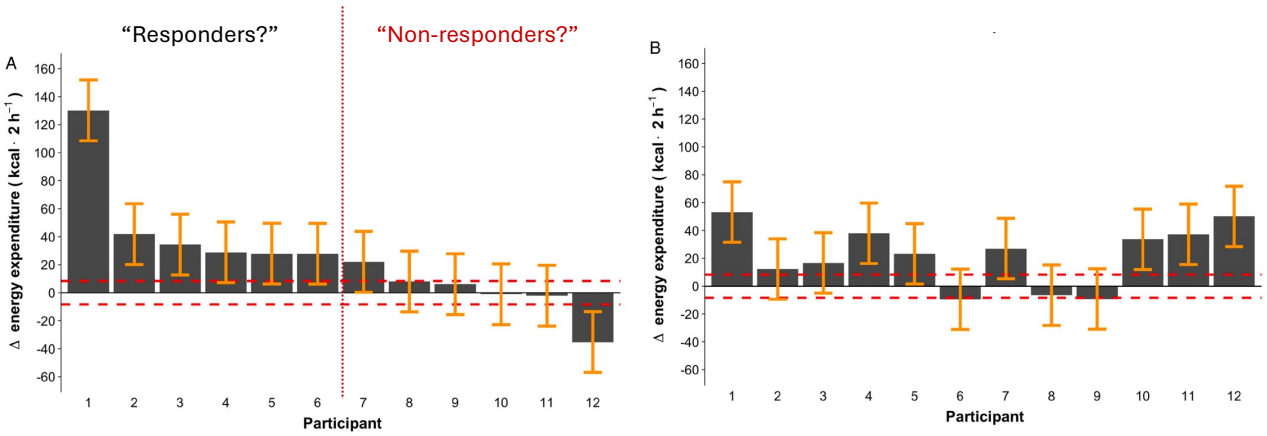
Goal: Identify those who can benefit



Data from Hengist et al., Ketogenic diet but not free-sugar restriction alters glucose tolerance, lipid metabolism, peripheral tissue phenotype, and gut microbiome: RCT. *Cell Rep Med*. 2024 ; 20;5(8):101667.

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Evidence of individual response is often prematurely claimed

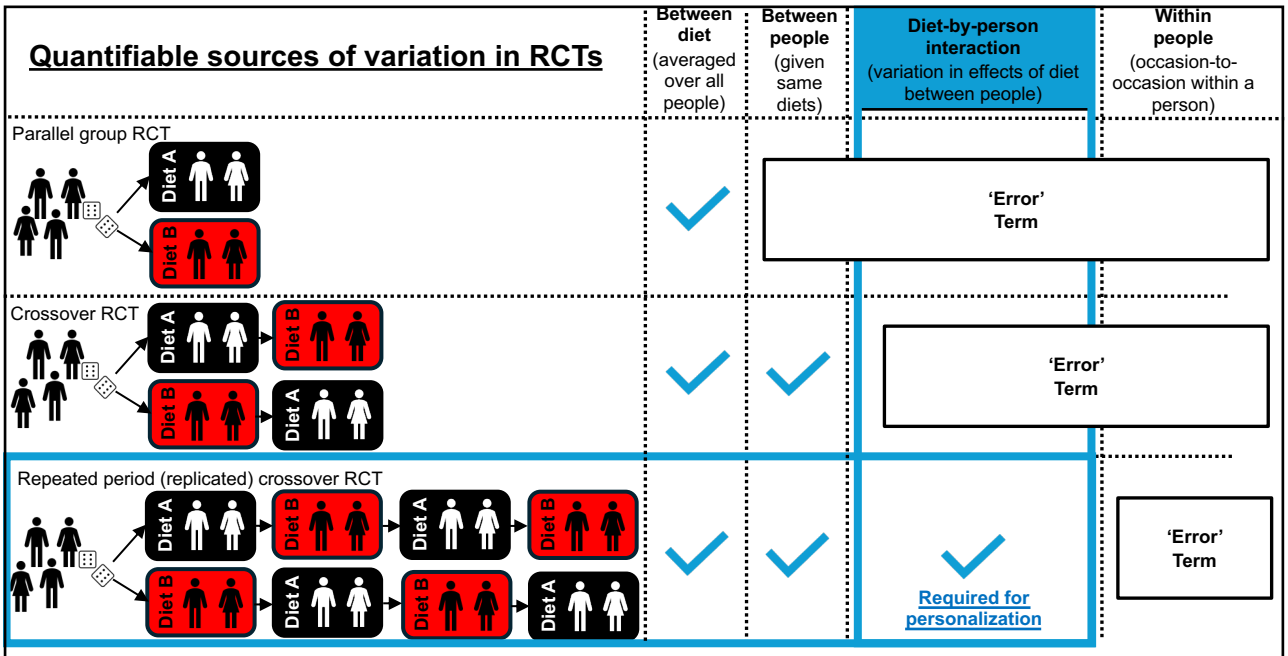


A) ~50% of individuals respond 100 % of the time
B) 100% of individuals respond ~50% of the time

Lolli L et al., Understanding Treatment Response Heterogeneity Using Crossover Randomized Controlled Trials: A Primer for Exercise and Nutrition Scientists. *Int J Sport Nutr Exerc Metab*. 2025; 28;35(6):465-492.

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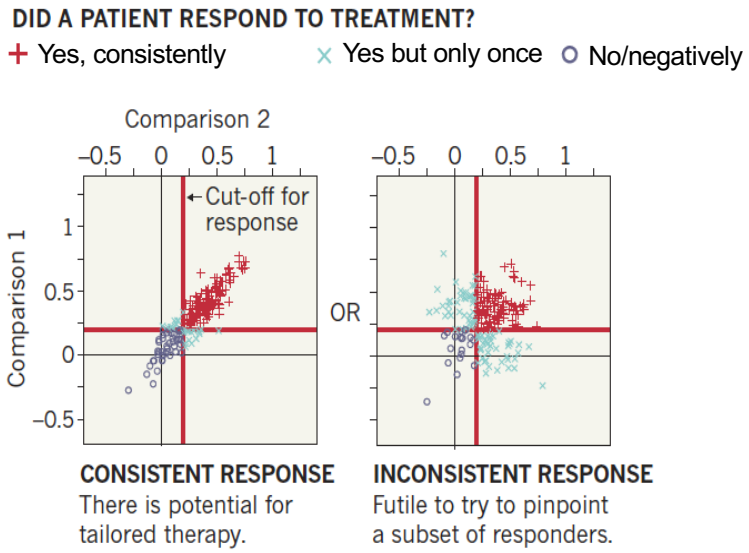
Quantifiable sources of variation in RCTs



Lolli L et al., Understanding Treatment Response Heterogeneity Using Crossover Randomized Controlled Trials: A Primer for Exercise and Nutrition Scientists. *Int J Sport Nutr Exerc Metab*. 2025; 28;35(6):465-492.

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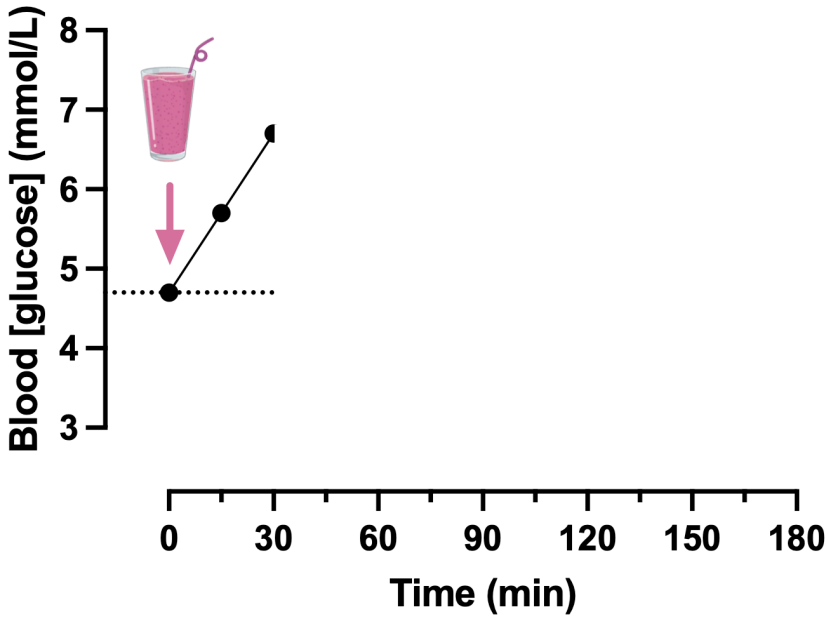
Identifying true individual responses to treatment



adapted from Senn S. Statistical pitfalls of personalized medicine. *Nature*. 2018;563(7733):619-621.

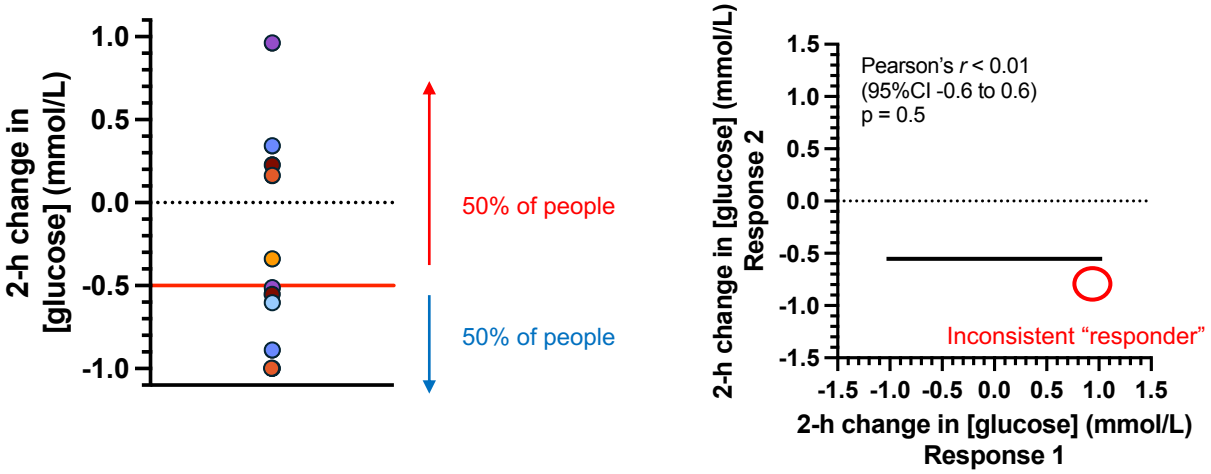
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Reactive hypoglycaemia (glucose ”dips”) as an example



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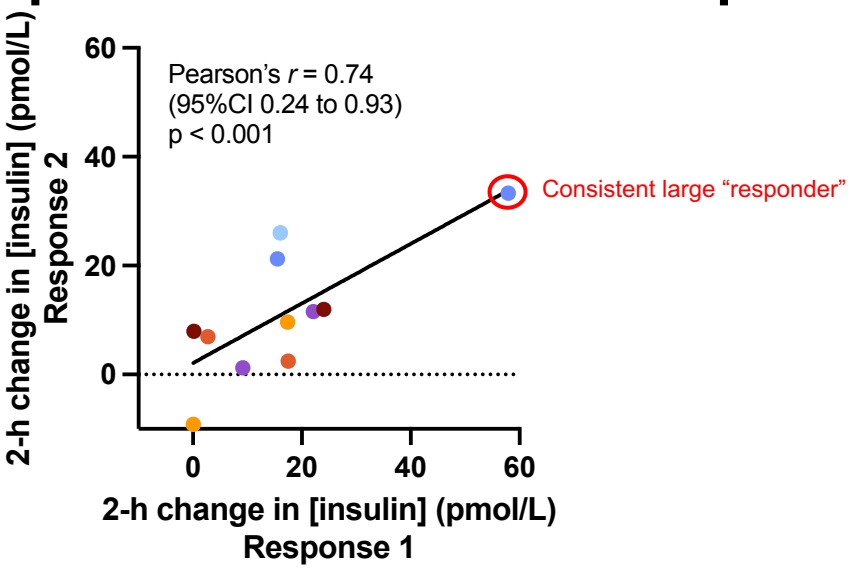
Within-person variance can often outweigh individual response



Gonzalez et al., Are there interindividual differences in the reactive hypoglycaemia response to breakfast? A replicate crossover trial. Eur J Nutr. 2024; 63(8):2897-2909.

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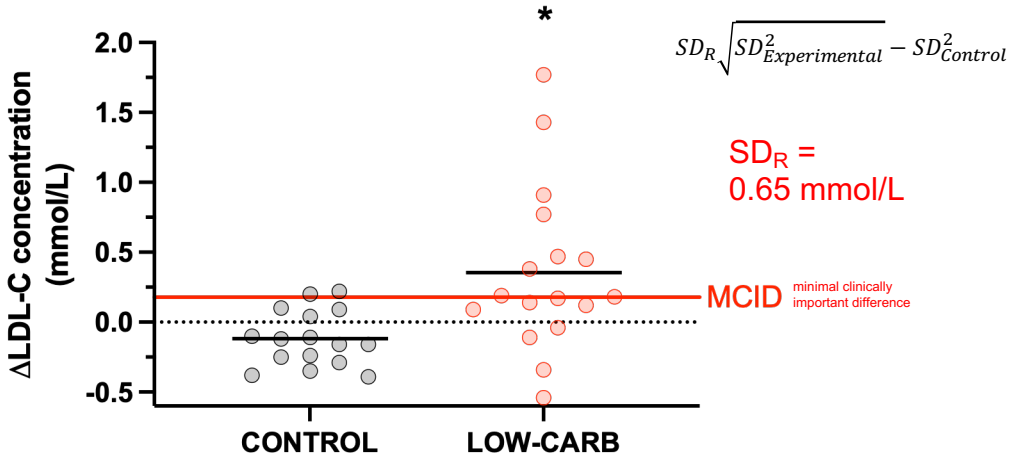
Individual response can be outcome-specific



Gonzalez et al., Are there interindividual differences in the reactive hypoglycaemia response to breakfast? A replicate crossover trial. Eur J Nutr. 2024; 63(8):2897-2909.

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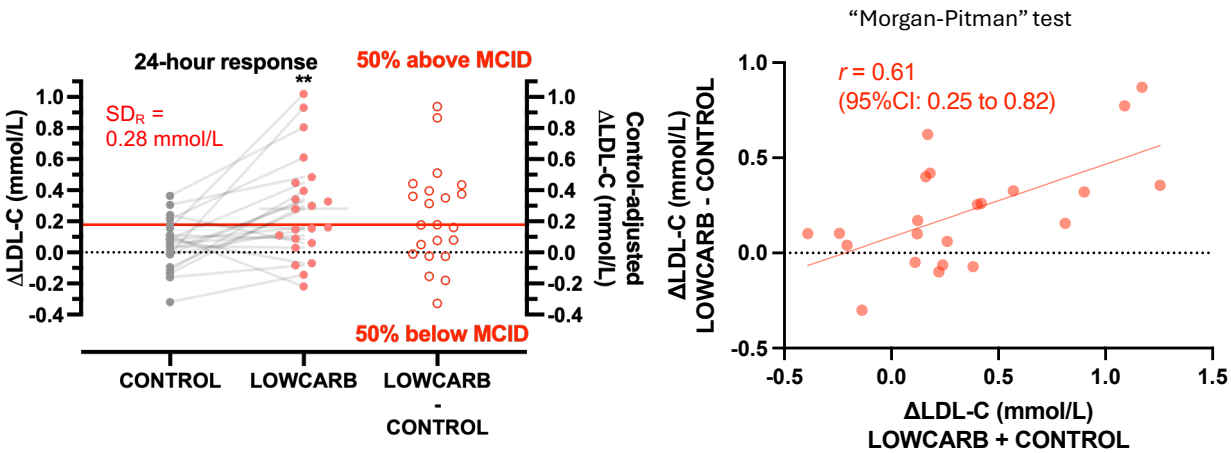
Can we get hints from non replicate RCTs?



Hengist et al., Ketogenic diet but not free-sugar restriction alters glucose tolerance, lipid metabolism, peripheral tissue phenotype, and gut microbiome: RCT. *Cell Rep Med*. 2024 ; 20;5(8):101667.

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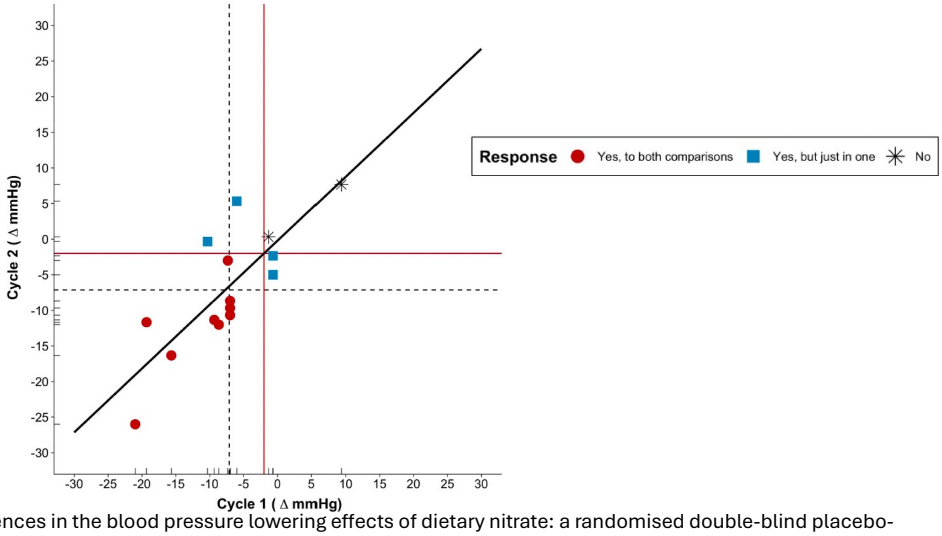
The LDL-C response to ketogenic diets may display inter-individual heterogeneity



Hengist et al. Restricting sugar or carbohydrate intake does not impact physical activity level or energy intake over 24 h despite changes in substrate use: a randomised crossover study in healthy men and women. *Eur J Nutr*. 2023; 62(2):921-940.

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Evidence of individual blood pressure response to dietary nitrate



Hayes et al., Inter-individual differences in the blood pressure lowering effects of dietary nitrate: a randomised double-blind placebo-controlled replicate crossover trial. *Eur J Nutr.* 2025; 64(2):101.

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Summary

Personalised nutrition is a worthy goal but requires solid evidence

Observed outcomes do not equal response

True treatment response heterogeneity requires specific designs

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