Check for updates

Received: 19 September 2025 | Accepted: 11 October 2025

DOI: 10.1111/dme.70163

DIABETIC Medicine

COMMENTARY

Physical activity (20 min) is a powerful adjunct to insulin for correcting hyperglycaemia in Type 1 diabetes: A paradigm shift

John S. Pemberton[1] | **Catherine L. Russon**[2] | **Richard M. Pulsford**[2] | **Brad S. Metcalf**[2] | **Emma Cockcroft**[2] | **Michael J. Allen**[2] | **Anne M. Frohock**[3] | **Rob C. Andrews**[2,4]

[1]Birmingham Women's and Children's Hospitals NHS Foundation Trust, Diabetes Centre, Steelehouse Lane, Birmingham, UK

[2]University of Exeter Medical School, Exeter, UK

[3]Oxford University Hospitals NHS Foundation Trust, Oxford, UK

[4]NIHR Exeter Clinical Research Facility, Exeter, UK

Correspondence

John S. Pemberton, Birmingham Women's and Children's Hospitals NHS Foundation Trust, Diabetes Centre, Steelehouse Lane, Birmingham B4 6NH, UK.
Email: johnpemberton@nhs.net

Achieving target glucose remains one of the most persistent challenges in Type 1 diabetes (T1D),[1] especially postprandially, where insulin cannot match rapid carbohydrate absorption.[2] In our recent publication in *Diabetic Medicine*, we applied a causal matched-pairs analysis to continuous glucose monitoring data, enabling comparisons of periods with and without physical activity under otherwise equivalent conditions.[3] When glucose was above 10 mmol/L (180 mg/dL), about 20 minutes of everyday activity lowered levels by approximately 2 mmol/L (40 mg/dL), with hypoglycaemia risk under 2%. These findings support a simple heuristic for education—'20 by 2' in mmol/L, or '20 by 40' in mg/dL—reframing physical activity as an acute, real-time adjunct to insulin therapy for hyperglycaemia.

This commentary places these findings in historical and clinical context, highlights the methodological advance of causal inference through matched-pair analysis and outlines the guardrails needed for safe translation into practice.

1 | FROM RISK TO OPPORTUNITY

The glucose-lowering effects of physical activity (PA) have been recognised for decades, but variability in individual responses has often been viewed as a barrier. In a pivotal analysis, Riddell and colleagues reported steep glucose declines in 120 adolescents with T1D undertaking 45–60 minutes of moderate walking or cycling within 4 h of prandial insulin, with hypoglycaemia in 44%.[4] This gave rise to the familiar phrase, 'the higher they start, the harder they fall'. Yet their secondary analysis, limited to PA events starting above 10.6 mmol/L (190 mg/dL) ($n = 41$), found that activity was effective at rapidly bringing glucose back into range, with hypoglycaemia risk under 10%.[3]

2 | FROM EDUCATION TO CLINICAL TRANSLATION

The first structured approach using PA to reduce hyperglycaemia was introduced at Birmingham Children's Hospital in 2019. Building on Riddell's findings,[4] young people and families were taught: if glucose is above 10 mmol/L, '15 minutes lowers it by 2 mmol/L'. In 2023, evaluation of this programme showed that those most engaged achieved the greatest time in range (TIR 3.9–10.0 mmol/L; 70–180 mg/dL) without more hypoglycaemia.[5]

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.
© 2025 The Author(s). *Diabetic Medicine* published by John Wiley & Sons Ltd on behalf of Diabetes UK.

3 | SCALING UP THE EVIDENCE

The next step was to test whether these findings held in larger, more diverse populations. The Type 1 Diabetes Exercise Initiative (T1DEXI) adult and paediatric cohorts (T1DEXIP) provided this opportunity. Analysis of nearly 2000 bouts lasting 10–60 minutes confirmed that when started above 10 mmol/L, PA consistently lowered glucose into the target range.[6] This effect was consistent across age, sex, regimen and activity type, establishing real-world evidence for PA in correcting hyperglycaemia.[6]

But this analysis lacked a control condition. To address this, in our analysis in this edition of *Diabetic Medicine*, we applied causal modelling via a within-subject matched-pairs framework, focusing on PA bouts of 10–30 minutes when starting above 10 mmol/L.[3] Each event was matched



FIGURE 1 The 20 by 2 rule for lowering hyperglycaemia with physical activity (mmol/L format) International equivalent of the 20 by 40 rule, showing that 20 minutes of light-to-moderate activity can reduce glucose by approximately 2 mmol/L when initial levels exceed 10 mmol/L. Physical activity should not be used to correct hyperglycaemia before breakfast or when ketones are elevated.

14645491, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/dme.70163 by NICE, National Institute for Health and Care Excellence, Wiley Online Library on [05/11/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

to a control period from the same individual, balanced on the four strongest predictors of glucose change: (i) starting glucose, (ii) glucose rate of change, (iii) insulin on board and (iv) preceding glucose variability. Robust matching across >1500 events, with balance confirmed by a standardised mean difference (SMD) of <0.001, established PA as the key determinant.

The analysis showed that 20 minutes of PA lowered glucose by approximately 2 mmol/L, an effect around 8-fold greater than matched control periods. Hypoglycaemia during or immediately after PA was very rare (less than 2%).[3] These findings provide the first causal-style evidence that short bouts of everyday activity can be prescribed as an acute glucose-lowering intervention for people with

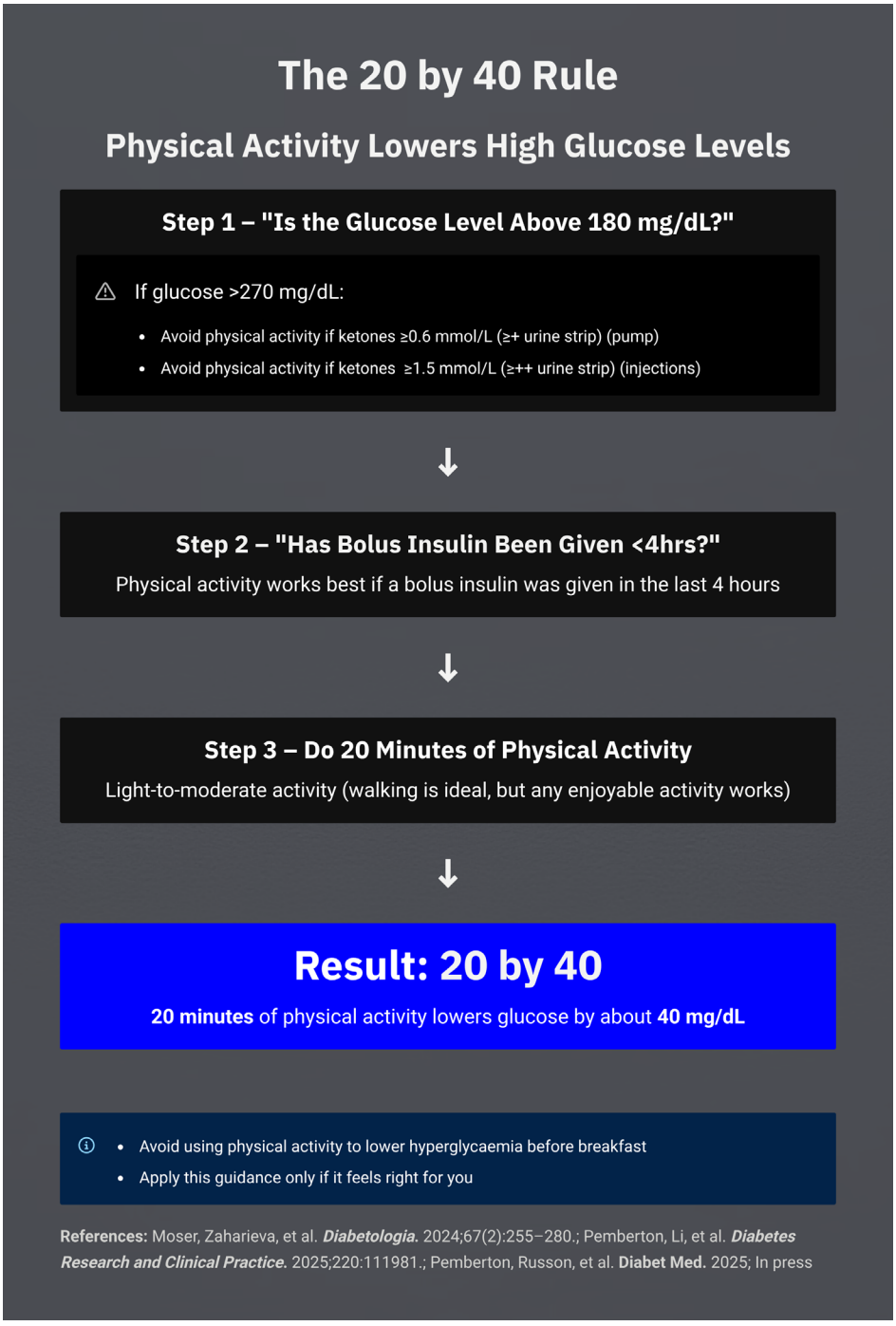

FIGURE 2 The 20 by 40 rule for lowering hyperglycaemia with physical activity. When glucose exceeds 180 mg/dL (10 mmol/L) and ketones are absent, 20 minutes of light-to-moderate activity such as walking typically lowers glucose by about 40 mg/dL. The effect is most pronounced if a bolus insulin dose was given within the previous 4 hours. Activity should be avoided if ketones are ≥0.6 mmol/L for pump users or ≥1.5 mmol/L for injection users.

14645491, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/dme.70163 by NICE, National Institute for Health and Care Excellence, Wiley Online Library on [05/11/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

T1D from age 12, across insulin regimens and activity types.[3] With evidence now secure, the next question is how to use PA safely in everyday practice.

4 | SAFETY CONSIDERATIONS

As with any therapy, PA requires guardrails. Two prequalifying questions emerge from the evidence:

1. *If glucose >15.0 mmol/L (270 mg/dL), are ketone levels below thresholds of concern?* For pump users, the recommended threshold is <0.6 mmol/L (<+ on a urine strip); for multiple daily injections, <1.5 mmol/L (<++ on a urine strip). Consensus guidelines from the European Association for the Study of Diabetes (EASD) and the International Society for Pediatric and Adolescent Diabetes (ISPAD) advise against PA when glucose is >15 mmol/L (270 mg/dL) with elevated ketones and recommend insulin correction and extra monitoring.[7]
2. *Has insulin been administered in the past 4 h?* PA is most effective when performed within 4 h of a bolus insulin dose.[3,4,6] 'Insulin on board' (IOB) is often used as a proxy for residual action, but calculators only imperfectly reflect pharmacokinetics.[8] A more practical check is simply to ask whether insulin has been delivered in the preceding 4 h, reflecting the IOB linear model used in T1DEXI analyses[3,6] and the timeframes within which PA was undertaken in prior studies.[4] If yes, PA functions as a potent adjunct to insulin.

5 | POSITIONING ALONGSIDE OTHER ADJUNCT THERAPIES

PA should also be considered alongside other adjunct therapies. The newer glucagon-like peptide-1 receptor agonists (GLP-1RAs) and dual agonists are emerging as leading candidates. For example, semaglutide (Ozempic®/Wegovy®) has been shown to improve glycaemic control, reduce weight and reduce insulin requirements when added to automated insulin delivery systems in adults with T1D.[9] A recent consensus outlined how GLP-1RAs could be integrated into care pathways.[10] These developments indicate a shift towards multimodal care. Within this model, PA is distinctive—safe, cost-free, accessible and deployable in real time with CGM.

6 | CONCLUSION: A PRAGMATIC HEURISTIC

The evidence supports a simple rule: when glucose is above 10 mmol/L, and provided that (i) bolus insulin has been delivered in the last 4 h, and (ii) if above 15.0 mmol/L (270 mg/dL), ketones are not elevated [≥0.6 mmol/L (≥+ on a urine strip) on pump therapy or >1.5 mmol/L (>++ on a urine strip) otherwise], then 20 minutes of almost any activity will lower glucose by approximately 2 mmol/L (40 mg/dL). This '20 by 2' (Figure 1) or '20 by 40' mg/dL (Figure 2) principle is reproducible across cohorts, therapies and demographics. While longer durations of activity may further reduce glucose, they also increase the likelihood of hypoglycaemia, particularly when insulin on board is present. Therefore, longer durations should be accompanied by more vigilance.

Reframing physical activity as a powerful, real-time glycaemic optimiser—rather than only a long-term health strategy—positions it as a safe, zero-cost therapy that, in the era of continuous glucose monitoring, delivers instant feedback and reinforces a virtuous cycle of activity driving better control. Future research should also explore whether short bouts of activity can be used pre-emptively to prevent post-prandial glucose excursions, in addition to their corrective role when glucose is elevated.

AUTHOR CONTRIBUTIONS

John Pemberton: Conceptualisation, Background research, Writing – original draft. Catherine L. Russon: Writing – review and editing. Richard Pulsford: Writing – review and editing. Bradley S. Metcalf: Writing – review and editing. Emma Cockroft: Writing – review and editing. Michael Allen: Analysis, Writing – review and editing. Anne-Marie Frohock: Writing – review and editing. Robert C. Andrews: Supervision, writing – review and editing, intellectual revision.

ACKNOWLEDGEMENTS

We would like to sincerely acknowledge the invaluable contributions of colleagues who have provided critical insight, discussion and foundational work in developing the concept of using physical activity to lower glucose in people with Type 1 diabetes. We are grateful to Dr. Suma Uday (Birmingham Women's and Children's NHS Foundation Trust) for her instrumental role in reporting the first clinical use of this approach in paediatric practice at Birmingham Children's Hospital. Dr. Dessi Zaharieva (Stanford University) for her guidance in shaping this concept and for her ongoing critical appraisal to ensure the strategy is presented as safe, effective and implementable. Professor Mike Riddell (York University, Canada) has been central in refining the concept and in securing support for the subsequent T1DEXI analyses of physical activity for ameliorating hyperglycaemia. Professor Othmar Moser (University of Bayreuth, Germany) has provided valuable feedback and contributed to the inclusion of this concept in the recent EASD/ISPAD position statement on automated insulin delivery systems. Dr. Peter Adolfsson (University of Gothenburg, Sweden) was the first

14645491, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/dme.70163 by NICE, National Institute for Health and Care Excellence, Wiley Online Library on [05/11/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

to formally publish this approach in the ISPAD 2022 guidelines, following critical discussions of the evidence dating back to 2019. We further wish to highlight the pioneering efforts of colleagues in curating and analysing the T1DEXI and T1DEXIP datasets, which have provided the essential infrastructure to examine this question in real-world, high-resolution data: Zoey Li, Robin L. Gal, Simon Bergford and Peter Calhoun (Jaeb Center for Health Research, Tampa, FL, USA); Lauren V. Turner and Michael C. Riddell (York University, Toronto, ON, Canada). Their sustained support has been instrumental in shaping the research direction and ensuring its translational relevance.

CONFLICT OF INTEREST STATEMENT

John Pemberton reports being on the advisory board for Abbott and ROCHE and speaker fees from Abbott, Dexcom and Insulet in the last 3 years. Faculty member of Exercise for Type 1 Diabetes. Catherine L. Russon, Richard Pulsford, Bradley S. Metcalf, Emma Cockroft, and Michael Allen have no conflicts. Anne-Marie Frohock reports consultancy fees for Insulet and speaker fees from Dexcom and Insulet in the last 3 years. Faculty member of Exercise for Type 1 Diabetes. Robert C. Andrews reports research funding from NovoNordisk Healthcare Organisation in the last 3 years, honoraria from NovoNordisk, AstraZeneca and Eli Lilly for education talks on diet and exercise to health care professionals. Co-founder of Exercise for Type 1 Diabetes.

GUARANTOR STATEMENT

John Pemberton is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

PRIOR PRESENTATION

Accepted for oral presentation at the European Association for the Study of Diabetes (EASD) Annual Meeting 2025, Vienna, Austria.

ORCID

John S. Pemberton https://orcid.org/0000-0002-0730-7879
Catherine L. Russon https://orcid.org/0000-0001-6785-6477
Richard M. Pulsford https://orcid.org/0000-0001-6880-7597
Brad S. Metcalf https://orcid.org/0000-0002-9142-3732
Emma Cockcroft https://orcid.org/0000-0003-3798-9492
Michael J. Allen https://orcid.org/0000-0002-8746-9957
Anne M. Frohock https://orcid.org/0000-0001-7159-2283
Rob C. Andrews https://orcid.org/0000-0003-4939-1738

REFERENCES

1. Crabtree TSJ, Griffin TP, Yap YW, et al. Hybrid closed-loop therapy in adults with type 1 diabetes and above-target HbA1c: a real-world observational study. *Diabetes Care*. 2023;46(10):1831-1838.
2. Slattery D, Amiel SA, Choudhary P. Optimal prandial timing of bolus insulin in diabetes management: a review. *Diabet Med*. 2018;35(3):306-316.
3. Pemberton J, Russon CL, Pulsford RM, et al. Glucose-lowering effects of physical activity in type 1 diabetes: a causal modelling and matched-pair analysis approach. *Diabet Med*. 2025. doi:10.1111/dme.70146
4. Riddell MC, Zaharieva DP, Tansey M, et al. Individual glucose responses to prolonged moderate intensity aerobic exercise in adolescents with type 1 diabetes: the higher they start, the harder they fall. *Pediatr Diabetes*. 2019;20(1):99-106.
5. Pemberton JS, Gupta A, Lau GM, Dickinson I, Iyer PV, Uday S. Integrating physical activity strategies to lower Hyperglycaemia in structured education Programmes for children and young people with type 1 diabetes improves Glycaemic control without augmenting the risk of Hypoglycaemia. Smart CE, editor. *Pediatr Diabetes*. 2023;2023:1-8.
6. Pemberton J, Li Z, Gal RL, et al. Duration of physical activity required to ameliorate hyperglycemia without causing hypoglycemia in type 1 diabetes: a T1DEXI adults and pediatric cohort analyses. *Diabetes Res Clin Pract*. 2025;220: 111981.
7. Moser O, Zaharieva DP, Adolfsson P, et al. The use of automated insulin delivery around physical activity and exercise in type 1 diabetes: a position statement of the European Association for the Study of diabetes (EASD) and the International Society for Pediatric and Adolescent Diabetes (ISPAD). *Diabetologia*. 2025; 68: 255-280.
8. Riddell MC, Lewis DM, Turner LV, Lal RA, Shahid A, Zaharieva DP. Refining insulin on board with netIOB for automated insulin delivery. *J Diabetes Sci Technol*. 2024 doi:10.1177/19322968241267820.
9. Shah VN, Akturk HK, Kruger D, et al. Semaglutide in adults with type 1 diabetes and obesity. *NEJM Evid*. 2025;4(8):EVIDoa2500173.
10. Shah VN, Peters AL, Umpierrez GE, et al. Consensus report on glucagon-like Peptide-1 receptor agonists as adjunctive treatment for individuals with type 1 diabetes using an automated insulin delivery system. *J Diabetes Sci Technol*. 2025;19(1):191-216.

How to cite this article: Pemberton JS, Russon CL, Pulsford RM, et al. Physical activity (20 min) is a powerful adjunct to insulin for correcting hyperglycaemia in Type 1 diabetes: A paradigm shift. *Diabet Med*. 2025;00:e70163. doi:10.1111/dme.70163

14645491, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/dme.70163 by NICE, National Institute for Health and Care Excellence, Wiley Online Library on [05/11/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License