

The Emerging Role of Continuous Glucose Monitors in Endurance Runners and Prediabetes Prevention

Farrah Shidid*

Physician Assistant Studies, Canisius University, Buffalo, USA

Email: Fshidid23@gmail.com

Abstract

Continuous Glucose Monitors (CGMs) are wearable forms of technology that have been traditionally used in diabetes management in order to improve glycemic control and reduce glycemic variability. More recently, CGMs have expanded into the field of endurance sports, particularly among long-distance runners who rely heavily on carbohydrate intake to support training and performance demands. This systematic review explores the long-term metabolic effects of frequent high carbohydrate intake in non-diabetic athletes, particularly since carbohydrate loading is essential for optimizing endurance performance. This study analyzes existing literature through a structured review of current evidence on continuous glucose monitors in diabetic and non-diabetic populations. Particular emphasis was placed on the potential of CGMs to enhance metabolic awareness and optimize nutritional strategies in endurance runners.

Keywords: Continuous Glucose Monitoring (CGM); Endurance Athletes; Endurance Runners; Pre-diabetes; Diabetes; Carbohydrate Loading; Glycemic Control; Glycemic Variability.

Received: 2/24/2026

Accepted: 4/24/2026

Published: 5/1/2026

* Corresponding author.

1. Introduction

Continuous glucose monitors are increasingly being explored beyond their traditional role in diabetes management. Due to the repetitive carbohydrate loading in endurance running, CGMs can provide real-time data and feedback to help athletes better understand their metabolic response during exercise and during carbohydrate loading phases two-three days before an endurance race. While transient increases in glucose levels between 140-180mg/dL occur following glucose consumptions during half and full marathons, these fluctuations highlight the importance of real-time metabolic monitoring [1,2].

When it comes to half and full marathon running, carbohydrates are critical energy sources for running and competition. Glycogen is a stored form of glucose that is essential for energy production in contracting skeletal muscles. However, due to the limited endogenous glycogen stores (liver: ~ 80-100g and skeletal muscle: 300-400g), its depletion is often associated with fatigue during half and full marathon running. With this in mind, endurance runners are recommended to consume 8-12 of carbohydrates per kg of body weight per day for 2-3 days prior to a race. The American College of Sports Medicine guidelines for carbohydrate consumption are per hour of exercise and recommends consuming 60 g carbohydrates for the first 2.5 hours of exercise and to consume up to 90 g of carbohydrates when exercise lasts more than 2.5 hours [2,3].

Despite the established role of carbohydrate loading in optimizing endurance, the frequent consumption of carbohydrates may have unintended metabolic consequences. The growing concern is that, over time, repetitive carbohydrate loading can lead to glucose dysregulation. However, carbohydrate loading is essential for maintaining energy availability and delaying fatigue during high-volume training [1,2]. The long term impact of CGM usage in relation to repeated carbohydrate loading and glycemic control on non-diabetic endurance runners remains an emerging area of research.

2. Background

Continuous glucose monitors allow users to track glucose trends in real time, providing immediate insight into how diet and activity influence blood sugar levels [4,5]. This wearable tool is an emerging area of interest, particularly within endurance running athletes. Due to the demands of running long distances, endurance athletes must undergo consistent carbohydrate loading in their training to effectively sustain high mileage running. However, frequent carbohydrate loading can lead to long term glucose dysregulation, especially if the athlete is already predisposed to diabetes.

3. Methods

A structured literature review was conducted to evaluate the role of CGMs in metabolic health and the potential application in endurance athletes. A thorough literature review was gathered from databases including PubMed, Google Scholar, and MEDLINE for relevant studies surrounding this topic. Search terms for this review included *carbohydrate loading*, *continuous glucose monitoring*, *endurance athletes*, and *glycemic variability*.

3.1 Inclusion Criteria

Studies that included randomized controlled trials, cohort studies, and review articles that evaluated CGM use in diabetic or non-diabetic populations were included. Studies specifically involving endurance exercise as well as endurance running were prioritized. Reported outcomes related to glycemic control, metabolic health, or exercise physiology were also gathered.

3.2 Exclusion Criteria

Studies that did not include finger stick readings and the inclusion of CGM data in diabetes management, along with non-human studies were excluded from this review. A total of 10 studies met inclusion criteria for this literature review emphasizing CGM usage. Data extracted key findings related to glycemic outcomes or performance-related measures. Findings were synthesized with attention to the strength and limitations of the available literature review.

4. Results

Literature evidence suggests that CGMs provide continuous and individualized metabolic feedback that can reveal glycemic changes during carbohydrate loading phases needed for endurance running. Although most CGM research has been emphasized for diabetes management, studies have been shown to prove the effectiveness of CGMs in non-diabetic users and endurance training. CGMs can be helpful when optimizing fueling strategies to help endurance athletes during their various strategies of carbohydrate loading and endurance training.

4.1 CGM Use in Diabetic Populations

Throughout multiple randomized controlled trials and cohort studies, CGM use was consistently associated with improved glycemic control. The authors in [5, 6] demonstrated reductions in HbA1c and decreased glycemic variability in patients with type 1 and type 2 diabetes, as further illustrated in Figure 1.

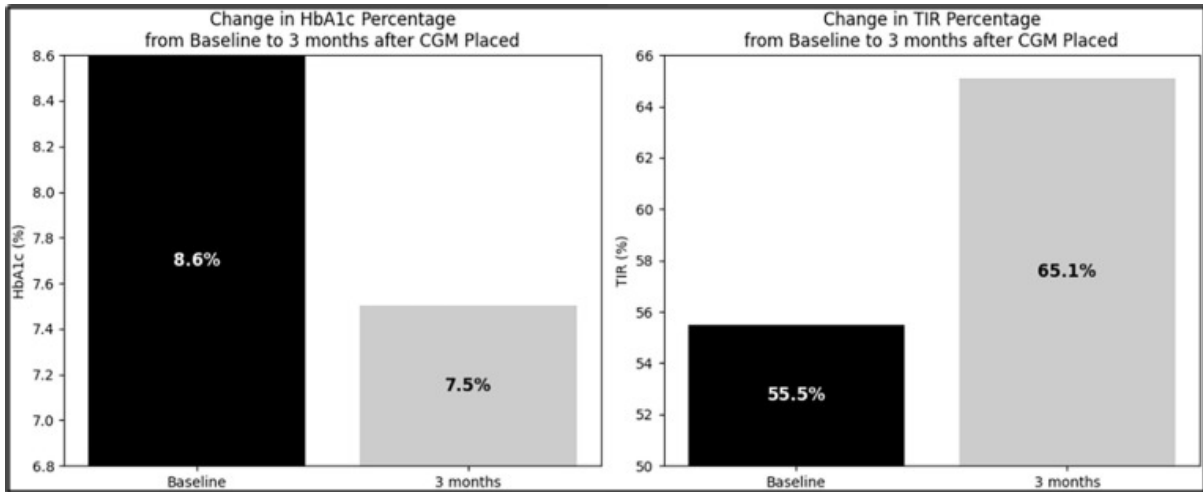


Figure 1: The first graph shows how HbA1c decreased from 8.6% to 7.5% over three months following CGM use in patients with type 1 and type 2 diabetes. The second graph demonstrates an increase in Time in Range (TIR)-the percentage of time blood glucose levels remain within a target, healthy range-after initiation of CGM

4.2 CGM Use in Endurance and Non-Diabetic Populations

Although a limited number of studies have directly evaluated CGM use in endurance athletes, Figure 2 demonstrates that CMs can be used during ultramarathon events (running events greater than 26 miles) to assess individualized carbohydrate requirements and monitor glucose trends in real time [7].

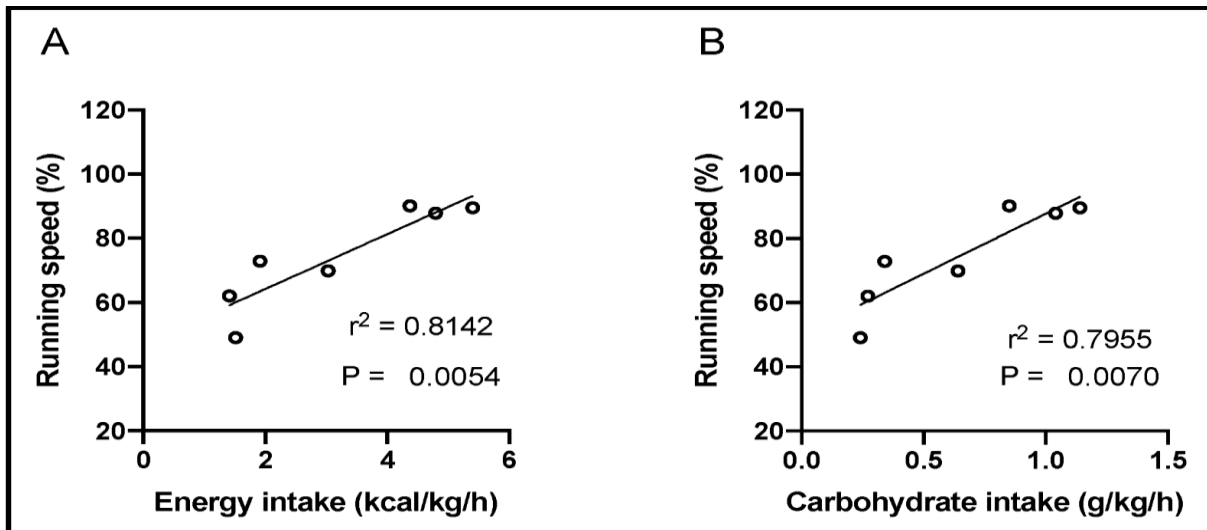


Figure 2: Scatter plots showing the positive relationship between glucose level and running speed. The intake of energy (A) and carbohydrate (B) were calculated based on consumed foods and consumed fluids

5. Discussion

This literature review highlights the established role of CGMs in diabetes management while examining their emerging role in endurance athletes. Strong evidence supports CGM use in diabetic populations, particularly for

improving glycemic control and reducing HbA1c variability [5,8]. However, there is limited targeted research to translate these findings to non-diabetic endurance athletes.

Endurance athletes rely heavily on carbohydrate fueling to sustain endurance performance. The literature obtained in this review has demonstrated a positive relationship between carbohydrate availability and endurance capacity [1,2]. Yet, the long-term metabolic implications of repeated carbohydrate loading is not yet fully understood. This literature review has suggested that high carbohydrate exposure may influence insulin sensitivity [9,10]. However, direct evidence in endurance athletes is still limited.

Emerging research data suggests that CGMs can provide real-time insight into glucose fluctuations during endurance running. As noted, *figure two*, demonstrated that CGMs can be used to assess individualized carbohydrate requirements during ultramarathon endurance running [7]. While these findings highlight a potential application for CGMs to athletes, this study is limited by small sample sizes of runners.

Additionally, long-term outcome data surrounding CGM usage for prediabetes prevention and endurance athletes is still early in its evaluation and additional longitudinal data is needed for further review. Future research should establish athlete-specific glycemic benchmarks, incorporate CGMs into longitudinal metabolic health data, and investigate how real-time feedback influences nutritional decision making and behavioral modification in endurance athletes. Despite these limitations, CGMs may offer a valuable tool for individualized metabolic monitoring. Real-time glucose feedback could support more informed nutritional decision-making, especially during periods of high training load and particularly relevant for athletes with a family history of diabetes [10]. As research evolves, wearable technology such as CGMs may help support evidence-based nutrition and metabolic strategies to improve athletic performance and long-term health.

6. Conclusion

Through literature review, it has been shown that CGMs hold an important role in not only improving metabolic health and can be positively translated into athletic performance and optimization. By utilizing CGMs, athletes who are at risk for pre diabetes can better manage glucose fluctuations and implement preventive nutritional strategies in their daily training to meet the metabolic demands of endurance running. There is still limited data and generalizability surrounding this study and more longitudinal research is recommended. As wearable technology advances, research bridging sports medicine, endocrinology and digital advancements can help improve overall health optimization for future research.

7. Disclosure

No conflict of interest to report.

Acknowledgments

The author thanks faculty of Canisius University Physician Assistant Program in providing feedback and support throughout this literature review.

References

- [1]. Vitale K, Getzin A. Nutrition and Supplement Update for the Endurance Athlete: Review and Recommendations. *Nutrients*. 2019;11(6):1289. Published 2019 Jun 7. doi:10.3390/nu11061289
- [2]. Murray B, Rosenbloom C. Fundamentals of glycogen metabolism for coaches and athletes. *Nutr Rev*. 2018;76(4):243-259. doi :10.1093/nutrit/nuy001
- [3]. Jiménez-Alfageme, R., Garrone, F. P., Rodríguez-Sánchez, N., Romero-García, D., Sospedra, I., Giménez-Monzó, D., Ayala-Guzmán, C. I., & Martínez-Sanz, J. M. (2025). Nutritional Intake and Timing of Marathon Runners: Influence of Athlete's Characteristics and Fueling Practices on Finishing Time. *Sports medicine - open*, 11(1), 26. <https://doi.org/10.1186/s40798-024-00801-w>
- [4]. Didyuk O, Econom N, Guardia A, Livingston K, Klueh U. Continuous Glucose Monitoring Devices: Past, Present, and Future Focus on the History and Evolution of Technological Innovation. *J Diabetes Sci Technol*. 2021;15(3) :676-683. doi:10.1177/1932296819899394
- [5]. Friedman JG, Cardona Matos Z, Szmuiłowicz ED, Aleppo G. Use of Continuous Glucose Monitors to Manage Type 1 Diabetes Mellitus: Progress, Challenges, and Recommendations. *Pharmgenomics Pers Med*. 2023;16:263-276. Published 2023 Mar 31. Doi :10.2147/PGPM.S374663
- [6]. DePasquale, H., DeLucenay, A., & Ahmed-Sarwar, N. (2025). Correlation of HbA1c and Continuous Glucose Monitor Time in Range. *The Journal of pharmacy technology : jPT : official publication of the Association of Pharmacy Technicians*, 87551225251348832. Advance online publication. <https://doi.org/10.1177/87551225251348832>
- [7]. Ishihara K, Uchiyama N, Kizaki S, Mori E, Nonaka T, Oneda H. Application of Continuous Glucose Monitoring for Assessment of Individual Carbohydrate Requirement during Ultramarathon Race. *Nutrients*. 2020;12(4) :1121. Published 2020 Apr 17. doi:10.3390/nu12041121
- [8]. Manov AE, Chauhan S, Dhillon G, et al. The Effectiveness of Continuous Glucose Monitoring Devices in Managing Uncontrolled Diabetes Mellitus: A Retrospective Study. *Cureus*. 2023;15(7):e42545. Published 2023 Jul 27. doi: 10.7759/cureus. 42545
- [9]. Hurwitz BE, Schneiderman N, Marks JB, et al. Adaptation of β -Cell and Endothelial Function to Carbohydrate Loading: Influence of Insulin Resistance. *Diabetes*. 2015;64(7):2550- 2559. doi:10.2337/db15-0106
- [10]. Gordon B, Kohn LA, Levine SA, Matton M, Scriver WDM, Whiting WB. Sugar content of the blood in runners following a marathon race: with special reference to the prevention of hypoglycemia: further observations. *JAMA*. 1925;85(7):508-509. doi:10.1001/jama.1925.02670070028009.