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Continuous Glucose Monitoring in Healthy Athletes: Current Evidence, Practical Applications and Limitations: A Narrative Review

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Abstract

Background. Continuous glucose monitoring (CGM) has gained increasing interest in sports science as a tool for evaluating glucose responses during exercise, recovery, and daily training in healthy athletes. Despite its growing popularity, the practical value of CGM in sport remains uncertain.

Aim. The aim of this narrative review was to critically evaluate the current evidence regarding the application of continuous glucose monitoring in healthy, non-diabetic athletes.

Materials and Methods. A narrative review of the literature was conducted using PubMed, Scopus and Web of Science. Original studies, systematic reviews, meta-analyses and consensus statements published in English were included. The retrieved literature was narratively synthesized according to the objectives of this review.

Results. Current evidence suggests that CGM improves understanding of individual glucose responses to exercise and nutritional interventions. However, methodological heterogeneity, variability among CGM systems, and the limited number of intervention studies restrict the practical application of current findings. There is currently insufficient evidence that routine CGM-guided interventions improve athletic performance or recovery in healthy athletes.

Conclusions. CGM represents a promising complementary tool for personalized athlete monitoring and sports nutrition. Nevertheless, further high-quality research is required before its routine use in healthy athletes can be recommended.

Keywords: continuous glucose monitoring; CGM; athletes; exercise; sports nutrition; glucose metabolism.

1. Introduction

Maintenance of glucose homeostasis is essential for sustaining exercise performance and supporting physiological adaptation to training. [15,39] During moderate- and high-intensity exercise, glucose serves as a major energy substrate, while also supporting central nervous system function and delaying fatigue. Because glucose availability is influenced by exercise intensity, nutritional status, and individual metabolic characteristics, understanding glucose responses has become an important aspect of sports nutrition and exercise physiology. [25,40]

Continuous glucose monitoring (CGM) enables real-time assessment of interstitial glucose concentrations and has recently gained considerable attention beyond diabetes care. [3,22,36] In sport, CGM is increasingly used to characterize individual glucose responses during training, competition, and recovery, reflecting the growing interest in personalized nutrition and individualized training strategies. [8,16,20]

Current evidence indicates that glucose responses vary substantially between individuals and are influenced by factors including exercise type and intensity, carbohydrate availability, meal timing, and habitual physical activity. [27] Consequently, CGM has been proposed as a tool to support nutritional planning and improve understanding of exercise metabolism. However, despite its growing popularity, evidence supporting routine CGM use in healthy athletes remains limited. Existing studies are characterized by small sample sizes, heterogeneous methodologies, and variability among CGM systems, making direct comparisons difficult and limiting the translation of findings into practical recommendations. [8,16]

Therefore, this narrative review critically summarizes the current evidence regarding the application of continuous glucose monitoring in healthy, non-diabetic athletes, with particular emphasis on exercise physiology, analytical performance, practical applications, current limitations, and future research directions.

2. Materials and Methods

This narrative review summarizes the available evidence on the use of continuous glucose monitoring (CGM) in healthy, non-diabetic athletes. The review focused on glucose regulation

during exercise, the principles of CGM, its use in sports nutrition, and its advantages and limitations.

A literature search was conducted using the PubMed, Scopus, and Web of Science databases. Articles published in English between 2014 and 2025 were mainly included. Older studies were also considered if they provided important information about glucose metabolism during exercise or the development of CGM technology.

The search included terms such as *continuous glucose monitoring*, *CGM*, *exercise*, *athletes*, *sports nutrition*, *glucose metabolism*, and *physical activity*. Both MeSH terms and free-text keywords were used.

Original studies, systematic reviews, meta-analyses, narrative reviews, and consensus papers were included. Preference was given to studies involving healthy adults and athletes. Studies focused only on people with diabetes were excluded unless they contained important information about CGM or glucose physiology relevant to healthy individuals.

The selected papers were reviewed and summarized according to the aims of this review, with attention to glucose regulation during exercise, the accuracy of CGM devices, practical applications, and the main limitations reported in the literature.

3. Research results

3.1. Physiological regulation of glucose

Blood glucose levels are regulated by the balance between glucose production, storage, and use. At rest, this process is mainly controlled by insulin and glucagon. Insulin helps cells take up glucose and store it as glycogen after meals, while glucagon increases glucose production in the liver during fasting to keep blood glucose levels stable. [32,42]

During exercise, muscles need more glucose for energy. [34] Muscle contractions increase glucose uptake, and the liver releases more glucose into the bloodstream. [1] Hormones such as glucagon and catecholamines also help maintain an adequate glucose supply. The use of carbohydrates depends on exercise intensity and duration. High-intensity exercise relies mainly

on muscle glycogen and blood glucose, while during prolonged exercise the body gradually uses more fat as glycogen stores decrease. [9,19,35]

3.2. Factors influencing glucose responses during exercise

Glucose responses during exercise differ between individuals and depend on many factors. Exercise intensity and duration, carbohydrate intake, training level, hydration, glycogen stores, meal timing, and environmental conditions can all affect glucose levels. [10,11,23]

Endurance-trained athletes usually use glucose and fat more efficiently than less trained individuals. [21] Recent studies also suggest that sex, menstrual cycle, sleep, and daily habits may influence glucose responses. As a result, athletes performing the same exercise often show different glucose patterns. [7,18]

Because of this individual variability, continuous glucose monitoring (CGM) can help identify personal glucose responses during training and recovery. Instead of looking for one "ideal" glucose pattern, CGM may support a more individualized approach to nutrition and training. [5,16]

3.3. Principles of continuous glucose monitoring

Continuous glucose monitoring (CGM) is a minimally invasive method that measures glucose levels in the interstitial fluid throughout the day. Unlike finger-prick blood glucose testing, CGM provides continuous measurements, making it possible to observe glucose changes during meals, exercise, recovery, and sleep. [22,36]

Because CGM measures glucose in interstitial fluid rather than blood, there is usually a delay of about 5–15 minutes between blood glucose and sensor readings. [44] This delay is most noticeable during intense exercise, after carbohydrate intake, and in the early recovery period. Therefore, CGM is more useful for monitoring glucose trends than single glucose values. [3,17]

Recent improvements have increased the accuracy and ease of use of CGM devices. Most systems also provide information about glucose variability and the direction of glucose changes.

However, the practical value of many of these measures in healthy athletes still needs further research. [8,16,20]

3.4. Strengths and limitations of CGM

One of the main advantages of CGM is continuous monitoring of glucose levels in everyday conditions. It allows athletes and researchers to observe how glucose changes during exercise, recovery, and different nutritional strategies. This information cannot be obtained from single blood glucose measurements. [12,22,33]

However, CGM does not replace blood glucose testing. Sensor accuracy may be affected by rapid glucose changes, hydration, skin temperature, tissue blood flow, and exercise itself. [4,29] In addition, different CGM devices may produce slightly different results.

Overall, CGM is most useful for identifying glucose patterns over time rather than measuring exact blood glucose values. [8,17]

3.5. Current state of evidence

The use of CGM in sports has increased in recent years because of growing interest in personalized nutrition and wearable technologies. [5,8] Although CGM was developed for people with diabetes, it is now also used to study glucose responses in healthy athletes.

Most available studies are observational or short-term experiments. [7,16] They show that athletes often have different glucose responses even when performing the same exercise. This suggests that glucose regulation depends on many factors, including nutrition, training status, and individual physiology. [6,16,43]

Despite these findings, there is still little evidence that using CGM improves sports performance or recovery in healthy athletes. Most studies describe glucose responses rather than testing whether CGM-based strategies lead to better training outcomes.

Another limitation is the large variation between studies. Researchers use different exercise protocols, nutrition plans, monitoring periods, and CGM devices, making it difficult to compare results. [8,22]

Overall, current research suggests that CGM is a useful tool for studying glucose responses during exercise. However, more well-designed studies are needed before its routine use in healthy athletes can be recommended. [8,16].

3.6. Glucose responses during exercise

Studies show that glucose responses during exercise are highly individual. Even athletes performing the same training session may have different glucose patterns. [7,20] These differences are related to factors such as glycogen stores, insulin sensitivity, nutrition, sleep, and daily habits. [6,30]

Exercise intensity also affects glucose levels. During moderate endurance exercise, glucose usually remains relatively stable if carbohydrate stores are adequate. High-intensity exercise often causes larger glucose fluctuations because of hormonal and metabolic changes. [35,41]

Nutrition before, during, and after exercise also influences glucose responses. [13,24,38] However, there is no evidence that one specific glucose pattern leads to better performance. Repeated monitoring of the same athlete seems to be more useful than comparing results between different athletes. [7,8,16]

3.7. Accuracy of CGM during exercise

Most studies show that modern CGM devices are reasonably accurate during rest and moderate exercise. [28,37] Their accuracy decreases when glucose levels change rapidly, for example during high-intensity exercise or soon after carbohydrate intake. [2,14,17]

Several factors may affect sensor performance, including hydration, skin temperature, blood flow, and the natural delay between blood and interstitial glucose. Different CGM systems also vary in their accuracy. [4,22]

For this reason, CGM should mainly be used to observe glucose trends over time rather than to make decisions based on a single measurement.

3.8. Practical implications

CGM can help athletes and practitioners better understand glucose responses during training, competition, and recovery. It may support more individualized nutrition and training strategies by showing how different athletes respond to exercise and carbohydrate intake. [31]

However, CGM data should always be interpreted together with other information, such as training load, diet, hydration, and recovery. At present, no CGM measurement has been shown to consistently improve athletic performance.

Current evidence suggests that CGM is a useful additional tool for athlete monitoring, but it should not replace other methods of performance assessment. More high-quality studies are needed to determine its role in everyday sports practice. [8,16,22].

4. Future perspectives

Despite the growing popularity of continuous glucose monitoring (CGM) in sport, substantial evidence gaps remain. Future studies should prioritize large, well-designed randomized controlled trials evaluating whether CGM-guided nutritional strategies improve athletic performance, recovery, or long-term training adaptation in healthy athletes. [8,16,20]

Standardization of study protocols, exercise conditions, and outcome measures is also required to improve comparability between studies. Furthermore, future research should include a broader range of athletic populations, including female athletes, strength-trained individuals, and team-sport athletes, who remain underrepresented in the current literature. [18,20]

Advances in wearable technology and data analytics may further enhance the practical value of CGM. [22,26] However, robust scientific evidence demonstrating clinically meaningful benefits should precede its routine implementation in sports practice.

5. Conclusions

Continuous glucose monitoring has expanded beyond diabetes care and is increasingly used in sports science to assess glucose responses during exercise and recovery. Current evidence indicates that CGM improves understanding of individual metabolic responses and may support personalized nutritional strategies. [5,25] However, available studies remain heterogeneous, and there is currently insufficient evidence to conclude that routine CGM-guided interventions improve athletic performance or recovery in healthy athletes.

At present, CGM should be considered a complementary monitoring tool rather than a standalone method for guiding training or nutritional decisions. [20,22] Future high-quality intervention studies are required to establish standardized approaches for interpreting CGM-derived data and to determine their practical value in healthy athletic populations.

Disclosure

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The authors deny any conflict of interest

Use of Artificial Intelligence

Artificial intelligence (ChatGPT, OpenAI) was used exclusively to support language editing, improve manuscript organization, and enhance readability. The authors were fully responsible for the critical evaluation of the scientific content, interpretation of the literature, verification of references, and preparation of the final version of the manuscript.

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