



# The Crucial Role of Carbohydrate Intake for Female Long-Distance Runners : A Literature Review

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**Abstract:** This research is a literature study that aims to explore the relationship between carbohydrate consumption and athlete performance and health, especially female athletes who run long distances. This study uses the method of literature study or literature review using secondary data from scientific journal articles. Article searches are conducted through various platforms such as Google Scholar, EBSCO, ScienceDirect, and Proquest using keywords related to carbohydrate consumption in female long-distance runners. The inclusion criterion for articles is that they must be scientific journal research articles conducted in the UK with the main subject female athletes long-distance runners and the topic relates to carbohydrates. Articles that meet these criteria are then further analyzed. Through an analysis of 8 scientific journal articles, it was concluded that carbohydrate intake has a crucial role in improving athletes' performance and endurance, as well as preventing the risk of low energy availability that can have a negative impact on health. In addition, research also highlights the need for adjustments in carbohydrate intake based on environment and stress to maximize athletes' training and recovery abilities. These findings affirm the importance of designing a balanced diet of carbohydrates and protein to achieve the desired results in improving athlete performance and supporting healthy weight loss. This study provides a deep understanding of the importance of carbohydrate intake in supporting the performance and health of female long-distance runners, and emphasizes the need for more inclusive research to develop better nutritional interventions.

**Keywords:** Athlete health; Carbohydrates; Female athletes; Sports nutrition; Sports performance

## Introduction

When a person begins an endurance training program, some of the fundamental adaptations that are considered most important in improving exercise performance consist of physiological, biochemical, and psychological changes (O'Connor et al., 2022). Physiological, biochemical and psychological changes are closely related to the correct eating habits of athletes in an effort to improve sports performance (Cadegiani & Kater, 2020; Longstrom et al., 2020; Martín-Rodríguez et al., 2024). Performance (running distance) is positively

correlated with energy intake and negatively with fluid intake, this means that as marathon runners energy needs before the race become important (Lavoué et al., 2020). Athlete performance and training adaptation are closely related to adequate and periodic intake of energy and macronutrients (Phillips, 2012; Stellingwerff, Morton, et al., 2019). Carbohydrates (CHO) are the superior macronutrients that fuel high-intensity exercise and allow athletes to train and compete (Moore et al., 2021). Long-distance running is one sport that requires extraordinary strength, endurance, and physical tenacity. For long-distance runners, both amateur and

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professional, proper nutrition plays an important role in improving athletic performance and endurance (Grzebisz, 2020; Williamson, 2016). One important aspect of nutrition for long-distance runners is carbohydrate intake (Grzebisz, 2020; Williamson, 2016).

Many studies have highlighted the effect of carbohydrate intake on the performance and fatigue level of distance runners (Bourdas et al., 2021; Cesanelli et al., 2021; Furber et al., 2021; Nielsen et al., 2020; Noakes, 2022). Consuming carbohydrates before, during, and after exercise can significantly affect athletic performance, especially in events lasting longer than 60 minutes (Bonilla et al., 2021). However, often amateur runners fail to meet the recommended level of carbohydrate intake, which affects their performance results (Sampson et al., 2023). The majority of middle-distance runners' workouts and races rely on providing energy derived from carbohydrates (Devrim-Lanpir et al., 2021). So to support the intensity of this exercise and competition, high carbohydrate intake must be a target.

Proper nutrition is essential for long-distance runners, especially when it comes to carbohydrate intake, as carbohydrates are the main source of energy during intense and prolonged physical activity (Amawi et al., 2023; Hawley & Leckey, 2015; Stellingwerff, Bovim, et al., 2019). For example, in a case study illustrating nutrition practices in a race, A female runner successfully completed her first 100 km ultraendurance off-road event in 12 hours 48 minutes 55 seconds (N. Berger et al., 2020; N. J. A. Berger et al., 2024). By consuming optimal energy and fluids, this not only helps maintain performance levels, but also prevents fatigue and dehydration from occurring which can have a negative impact on runners' performance and health (Burke et al., 2019; Martínez-Sanz et al., 2020; Stellingwerff, Bovim, et al., 2019).

Sometimes, meeting the energy needs of long-distance runners can be challenging, but it is critical to support optimal performance and health during training and competition (Bargoria et al., 2020; Scheer et al., 2022). It is important to understand and study more about carbohydrate intake in long-distance running. Current research needs to pay attention to aspects that are still underrepresented, such as the participation of women, adolescents, and older runners (Ammassari et al., 2023; Greenfield et al., 2021; Ward et al., 2023). Each of these groups has different physiological needs and responses to carbohydrate intake, which can affect their performance and recovery (Abreu et al., 2021; Fernandes, 2020; Nightingale et al., 2018). With a better understanding of how carbohydrates affect athletic performance and endurance in these various population groups, we can develop more targeted nutrition strategies. This will allow long-distance runners from all backgrounds to achieve peak performance and improve

their overall health and endurance. Comprehensive, inclusive research will help create more effective nutrition guidelines, supporting all athletes to achieve their goals in long-distance running.

In this paper, we will explore current research on the role of carbohydrates in long-distance runner performance, highlight key findings and identify areas where more research is still needed. In addition, we will also explore nutritional strategies that can help female runners improve endurance and achieve optimal results in long-distance running. Thus, this paper will provide a deeper insight into the importance of carbohydrate intake in achieving peak performance for long-distance runners, especially women.

Therefore, the review article aims to provide information related to the potential of chemical compounds and pharmacological bioactivity found in cinnamon plants, so that it can be used as parameters for future researchers and the public, especially since a better understanding of the timing and optimal amount of carbohydrate consumption is essential for long-distance runners, especially women, to improve their endurance and achieve peak performance levels.

## Method

This research is library research, which is a series of studies related to library data collection methods, or research whose research objects are traced and explored through various literature information through (books, encyclopedias, scientific journals, newspapers, magazines, and documents (Arikunto, 2010). Literature review or literature review is research that reviews and critically examines ideas, or findings contained in academically oriented literature and formulates theoretical and methodological contributions to certain topics. The data used in this study are secondary data.

The strategy of searching for publication articles is carried out using keywords on various platforms such as Google Scholar, EBSCO, ScienceDirect, and Proquest, as well as access to other leading journal searches with selected keywords, namely: carbohydrate consumption in female athletes of long-distance runners. Articles or journals that fit these criteria will be taken for further analysis. This literature review uses literature sources that can be accessed in full PDF format and come from scientific journals (peer-reviewed journals). The criteria for the journal reviewed were research journal articles in the UK with the subject of long-distance female runners. The type of article searched is a research journal article, not a literature review, with the main theme about carbohydrates. Journals that meet these criteria will then be reviewed and analyzed to gain a deep understanding of the topic.

## Result and Discussion

In this literature review, there are 8 journal articles that will be analyzed further. These articles are grouped based on the scope of discussion so that articles are

obtained that specifically discuss carbohydrate intake in female runners. This grouping aims to gain in-depth insights into the topic from various research perspectives. For more details can be seen in the Table 1

**Table 1.** Summary of data descriptions

Author	Heading	Method	Result
(Kettunen et al. 2023)	Nutritional intake and anthropometric characteristics are associated with endurance performance and markers of low energy availability in young female cross-country skiers.	The study analyzed 23 young female athletes over one year. Participants recorded food and training logs, and used laboratory tests and the LEAF-Q questionnaire to calculate energy availability and assess LEA risk.	Energy and carbohydrate intake were below recommendations, protein and fat intake were adequate. Body mass, height, BMI, FFM, and FM increased, while relative VO2max decreased. Higher training volume improved performance measures.
(Podlogar and Wallis 2022)	New Horizons in Carbohydrate Research and Application for Endurance Athletes.	The research involved young female cross-country skiers over a year, assessing their nutrition intake, anthropometric changes, training volume, and performance.	Rapid glycogen repletion requires tailored carb intake. Composite carbs expedite liver glycogen replenishment, impacting exercise capacity. Environmental stress alters carb metabolism, necessitating adaptation.
(Ding et al. 2022)	Effect of a carbohydrate-rich beverage on rate of cesarean delivery in primigravidae with epidural labor analgesia: a multicenter randomized trial	A multicenter trial in China, approved by ethics committees, tested carb-rich vs. low-carb drinks on primigravidae in labor, randomizing via sealed envelopes. Outcome measures included cesarean rates and labor duration.	Cesarean rates didn't significantly differ between groups, even after adjusting for fluid intake. The carb-rich group experienced less post-birth hunger but higher maternal blood glucose levels and hyperglycemia incidence. No maternal hypoglycemia cases occurred.
(Tanous et al. 2022)	Dietary carbohydrate rather than protein intake drives colonic microbial fermentation during weight loss	Overweight or obese males underwent a cross-over study, consuming a maintenance diet followed by three 10-day weight loss diets: NPWL, NPAAWL, and HPWL. Faecal samples were analyzed via LC-MS/MS to assess dietary metabolites' impact on colonic fermentation.	NPWL diet showed minimal faecal metabolome changes; NPAAWL and HPWL reduced carb-related and increased protein-related metabolites, emphasizing carb's role in colonic fermentation. Balancing dietary carb and protein is crucial in weight loss diet design, influencing gut health and metabolic processes.
(Huang et al. 2020)	Low-osmolality carbohydrate-electrolyte solution ingestion avoid fluid loss and oxidative stress after exhaustive endurance exercise	Twelve healthy males from Taipei Medical University participated, following a double-blind crossover design. They consumed either a low-osmolality carb-electrolyte solution or water pre/post exhaustive endurance exercise. Various parameters, including dehydration rates and oxidative stress indicators, were measured through blood samples.	Participants consuming LCS showed lower dehydration rates post-EEE. LCS intake led to higher catalase levels and slightly lower protein carbonyl concentrations, suggesting antioxidant effects. Overall, LCS aids in post-exercise recovery and oxidative stress management.
(Gratz et al. 2019)	Dietary carbohydrate rather than protein intake drives colonic microbial fermentation during weight loss	Overweight/obese males underwent a cross-over study consuming maintenance then 3 weight loss diets: NPWL, NPAAWL, and HPWL. Faecal samples analyzed via LC-MS/MS showed NPWL minor changes, while NPAAWL and HPWL	NPWL diet caused minimal faecal metabolome changes, while NPAAWL and HPWL reduced carb-related and increased protein-related metabolites. Dietary carbs primarily drove colonic fermentation, underscoring the

Author	Heading	Method	Result
(Mata et al. 2019)	Carbohydrate availability and physical performance: physiological overview and practical recommendations	reduced carb-related and increased protein-related metabolites. Balancing dietary carb and protein crucial in designing effective weight loss diets. The narrative review provides a comprehensive overview of CHO's impact on performance, emphasizing nutrition's role in exercise adaptations. Practical recommendations for CHO periodization stress adjusting nutrition to training goals.	need for balanced carb-protein intake in weight loss diets. CHO availability significantly affects physical performance, with nutritional periodization optimizing exercise intensity and promoting adaptations. 'Training low' protocols enhance performance in endurance athletes without immune system compromise. Post-exercise glycogen restoration strategies impact recovery and performance.
(King et al. 2022)	Short-Term Very High Carbohydrate Diet and Gut-Training Have Minor Effects on Gastrointestinal Status and Performance in Highly Trained Endurance Athletes	Two athlete groups (MAX and CON) aimed to enhance CHO availability. Nineteen male race walkers and eighteen distance runners participated. Assessments included a 26 km race-walk and a 35 km run supported by interventions like high CHO diet and gut-training.	Post-exercise, I-FABP increased significantly but was likely clinically insignificant. MAX group had increased GIS, particularly upper GIS, compared to CON. Despite higher carb intake, no major differences in I-FABP or GIS. Both groups showed decreased claudin-3 response. Performance improvement was similar, suggesting additional carb availability may not offer extra benefits.

The reviewed article provides an in-depth understanding of the relationship between nutrient intake, especially carbohydrates, and athlete performance and health, particularly among female athletes who participate in endurance sports such as cross-country skiing. These findings highlight the importance of paying attention to adequate nutrient intake, especially carbohydrates, to support optimal performance and reduce the risk of low energy availability (LEA) that can negatively impact athletes' health. In addition, research has also shown that environment and stress can affect carbohydrate metabolism, so it is important to make adjustments in carbohydrate intake to maximize the athlete's training and recovery abilities. In addition, the emphasis on the balance between carbohydrate and protein intake is also highlighted in these articles, especially in the context of recovery and weight loss. These findings affirm the importance of designing a balanced diet to achieve the desired effects, both in improving athlete performance and in supporting a healthy weight loss process.

Thus, a comprehensive understanding of the role of carbohydrates in athlete nutrition is key in achieving optimal performance and maintaining overall health. Daily food intake is very important to maintain health and determine endogenous fuel to train endurance

(Passos et al. 2019). The consumption of carbohydrates (glucose) during exercise becomes a mode of exercise that presents unique metabolic needs in athletes due to the combined use of muscles. Consumption of an 18% multi-transport carbohydrate solution with gelled polysaccharides was well tolerated for 120 minutes in submaximal exercise, but did not improve performance to the maximum (Pettersson et al. 2019).

Adequate glycogen storage is important for an athlete's endurance to compensate for fatigue symptoms and to maintain a high level of work. Experts no longer recommend high-carb dietary habits for competitive athletes, but suggest periodizing carbohydrate intake depending on the intensity and duration of training sessions and the purpose of training blocks. If the goal is to eliminate fat, increase fat utilization, or increase endurance capacity through long, slow duration exercise, then an overall decrease in carbohydrate intake may be recommended or by changing the timing of intake (Casazza et al. 2018).

CHO during exercise can optimize endurance performance (Reinhard and Galloway 2022). A study showed that the women examined used an abnormal hypoenergetic diet with too low carbohydrate content that was relatively more beneficial than the absolute amount of protein, fat, and carbohydrates consumed

(Pilis et al. 2019). In this case, it shows the amount of carbohydrate consumption for female athletes can be adjusted to the training capacity they do.

## Conclusion

Carbohydrate consumption for female long-distance runners is needed as the main energy in the form of exercise that involves endurance. Carbohydrates as nutrients are most quickly absorbed by the body. Running a marathon is both a physical and mental activity. Runners consume food products containing carbohydrates to replenish glycogen stores to maintain their marathon performance. Female and male athletes have differences in both physiological and psychological characteristics related to endurance performance. So that the role of the coach is very useful in determining the scope of nutrition that will be consumed by athletes both during training and competing.

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## Author Contributions

This article was written by six contributors, Reza Restu Illahi contributed to the writing of the introduction, methodology, literature review, results, and conclusions. Willadi Rasyid, Hendri Neldi, Padli contributed to the process of conceptualization, methodology, review, and finalization of articles. Yovhandra Ockta contributed to the finalization and improvement of the content of the article. Firunika Intan Cahyani contributed to reviews in different thought sections.

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The content of this article does not create a conflict of interest

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