



Ketosis and Protein Loading: The Implications of the Dukan Diet on Endurance in Competitive Sports

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ABSTRACT

This research explores the implications of ketosis and protein loading, as induced by the Dukan Diet, on endurance in competitive sports. The Dukan Diet, known for its high-protein, low-carbohydrate approach, promotes a metabolic state where the body uses fat as its primary energy source. This shift to fat oxidation has potential benefits for endurance athletes, particularly those involved in ultra-endurance sports. The study examines how ketosis conserves glycogen stores and enhances fat metabolism, offering sustained energy for long-duration activities. However, the research also highlights the challenges athletes face with carbohydrate restriction, especially during high-intensity efforts that depend on glycogen. The role of protein loading in muscle preservation and recovery is discussed, along with the diet's long-term sustainability and psychological impacts on athletes. The findings suggest that while the Dukan Diet may benefit endurance performance, its restrictive nature and the potential trade-offs between fat and glycogen metabolism raise important considerations for athletes seeking to optimize both endurance and high-intensity performance.

Keywords: Ketosis, Protein Loading, Dukan Diet, Endurance Sports, Fat Oxidation

Introduction

Endurance, a critical component of success in competitive sports, has long driven athletes and researchers to explore various nutritional strategies that can enhance performance, optimize recovery, and maintain muscle mass. One such strategy that has garnered significant attention is the Dukan Diet, known for its high-protein, low-carbohydrate approach that induces ketosis—a metabolic state where the body relies primarily on fat for energy instead of carbohydrates (Bracci et al., 2022). Originally developed by Dr. Pierre Dukan, this diet promotes weight loss while preserving lean body mass, making it an attractive option for athletes seeking to improve endurance without sacrificing strength (Pietrzak et al., 2023). The Dukan Diet is divided into four distinct phases: the Attack, Cruise, Consolidation, and Stabilization phases, each designed to progressively introduce or restrict certain food groups while maintaining an overarching emphasis on protein intake (McAlister, 2020). In the Attack phase, lean proteins are the sole focus, leading to rapid weight loss through thermogenesis and minimal glycogen storage. The Cruise phase allows the gradual reintroduction of vegetables, but carbohydrates remain restricted to keep the body in a fat-burning state. During the Consolidation phase, dieters slowly add some carbohydrates and fats, though the diet continues to prioritize protein to prevent weight regain (Brisebois et al., 2022). Finally, the Stabilization phase aims to maintain the achieved weight loss long-term by advocating a sustainable balance of macronutrients, with specific "protein days" as a safeguard against weight gain (Kopeć & Zawistowski, 2025).

In the context of sports, particularly endurance-based activities such as long-distance running, cycling, and swimming, the Dukan Diet's impact on performance is a subject of both intrigue and debate. Endurance athletes traditionally rely on carbohydrates as their primary energy source, given the body's ability to quickly convert glycogen into glucose, fueling prolonged physical exertion (Brisebois et al., 2022). However, the Dukan Diet significantly reduces carbohydrate intake, pushing the body into ketosis—a state where ketones, derived from fat breakdown, become the primary fuel source. This shift in metabolic pathways can potentially offer advantages for endurance athletes, particularly in ultra-endurance events where fat stores can provide a more sustained energy source compared to glycogen, which depletes relatively quickly. The ketogenic state has been shown to enhance fat oxidation, reduce reliance on muscle glycogen, and potentially delay the onset of fatigue in endurance athletes. These factors suggest that ketosis, as induced by the Dukan Diet, could provide an alternative energy pathway for athletes engaged in long-duration sports, promoting endurance by conserving glycogen stores and optimizing fat utilization (Spadine & Patterson, 2022).

However, the relationship between ketosis and endurance performance is complex and multifaceted. While fat oxidation can provide a stable energy supply for lower-intensity, long-duration exercise, high-intensity bursts—common in competitive sports—still rely heavily on glycogen. This presents a challenge for athletes following the Dukan Diet, as glycogen stores may be insufficient to support peak performance during these critical moments. Additionally, the initial stages of the diet, particularly the Attack phase, may induce feelings of fatigue, lethargy, and decreased performance due to the

lack of carbohydrates, which are essential for immediate energy (Turner, 2010). Athletes may also experience slower recovery times due to limited glycogen replenishment, a vital aspect of post-exercise recovery and subsequent performance. Another crucial aspect of the Dukan Diet is its emphasis on protein loading, which plays a significant role in muscle preservation and recovery (Brisebois et al., 2022). For endurance athletes, maintaining lean muscle mass is essential not only for performance but also for preventing injury and sustaining long-term physical health. The high protein intake prescribed by the Dukan Diet supports muscle repair and recovery, counteracting the catabolic effects of long-duration exercise, which can lead to muscle breakdown over time. Protein also has a thermogenic effect, which may increase metabolic rate and enhance fat oxidation—potentially contributing to improved body composition and endurance. However, excessive protein consumption without adequate carbohydrate intake may lead to impaired muscle glycogen synthesis, which is crucial for replenishing energy stores post-exercise (McAlister, 2020). This trade-off between fat oxidation and glycogen replenishment is central to the debate on the Dukan Diet's efficacy in supporting endurance athletes. Furthermore, while the Dukan Diet may offer benefits such as improved fat metabolism and muscle preservation, it raises questions about its long-term sustainability for athletes. Endurance sports require a delicate balance of macronutrients, and prolonged carbohydrate restriction could lead to nutrient deficiencies, electrolyte imbalances, and increased risk of injury due to inadequate recovery (Brisebois et al., 2022). The body's ability to adapt to fat as a primary energy source varies among individuals, and not all athletes may respond favourably to the ketogenic state induced by the Dukan Diet. Moreover, the diet's restrictive nature could potentially lead to psychological stress, as athletes may struggle to meet their energy demands while adhering to the diet's limitations (Regula et al., 2018).

The Dukan Diet's emphasis on ketosis and protein loading presents a unique nutritional strategy that may benefit certain endurance athletes, particularly in ultra-endurance sports where fat oxidation plays a significant role in energy metabolism. The diet's high protein intake supports muscle preservation and recovery, potentially aiding athletes in maintaining lean mass over the course of long-duration exercise (McAlister, 2020). However, the significant reduction in carbohydrates, which are crucial for high-intensity performance and recovery, poses challenges for athletes who require rapid glycogen replenishment. The diet's efficacy in enhancing endurance remains a subject of debate, with potential benefits tempered by concerns about sustainability, nutrient deficiencies, and the ability to meet the energy demands of competitive sports (Brisebois et al., 2022). As athletes continue to explore dietary strategies to optimize performance, the Dukan Diet offers a compelling but complex approach that warrants further investigation in the context of endurance sports (Pietrzak et al., 2023).

Impact of Ketosis on Energy Utilization in Endurance Sports

Ketosis, a metabolic state in which the body primarily uses fat for energy instead of carbohydrates, is central to understanding the Dukan Diet's potential impact on endurance sports. Traditionally, athletes rely on glycogen, stored in muscles and the liver, as the primary fuel source during endurance activities. However, glycogen stores are limited, leading to depletion and fatigue during prolonged exercise. In contrast, ketosis offers an alternative energy pathway by utilizing fat stores, which are far more abundant. When carbohydrates are restricted, as in the Dukan Diet, the body produces ketones, derived from fat breakdown, to fuel prolonged exercise (Bracci et al., 2022). This shift in energy utilization can offer significant benefits for endurance athletes engaged in activities such as marathon running, long-distance cycling, and triathlons.

One of the primary advantages of ketosis for endurance athletes is the increased reliance on fat oxidation. Unlike glycogen, which is limited in supply and can be depleted after a few hours of strenuous activity, fat reserves provide a virtually limitless energy source. This is particularly beneficial for ultra-endurance events where athletes need a sustained, long-lasting energy supply. Ketosis allows the body to conserve glycogen stores for moments of high-intensity effort, while primarily using fat to maintain energy levels during lower-intensity, prolonged phases of exercise. As a result, athletes in ketosis may experience delayed onset of fatigue, enabling them to perform at a steady pace for extended periods (Spadine & Patterson, 2022). Research suggests that athletes who adapt to a ketogenic state may experience improved fat metabolism efficiency, further enhancing endurance capacity. By training the body to optimize fat utilization, ketogenic athletes may reduce the need for frequent carbohydrate intake during long events, potentially minimizing gastrointestinal discomfort caused by carbohydrate-heavy sports nutrition. This fat-adaptation process, which is central to the Dukan Diet, could lead to greater metabolic flexibility, allowing athletes to switch more efficiently between fat and glycogen as fuel sources, depending on the intensity of the activity. However, the benefits of ketosis in endurance sports are not without limitations (Altashina et al., 2020). While fat provides a stable energy source for low-to-moderate intensity exercise, high-intensity efforts still rely heavily on glycogen (Brisebois et al., 2022). In sports that require sudden bursts of speed or power, such as sprint finishes in a race or climbing hills in cycling, athletes in a ketogenic state may experience decreased performance due to limited glycogen availability. Additionally, the initial adaptation phase to ketosis, which can last several weeks, may cause fatigue, lethargy, and impaired performance as the body adjusts to burning fat instead of carbohydrates (Spadine & Patterson, 2022).

Role of Protein Loading in Muscle Preservation and Recovery

Protein loading, a key component of the Dukan Diet, plays a crucial role in muscle preservation and recovery, particularly for endurance athletes. In sports that demand prolonged physical exertion, muscle breakdown is a common issue due to the catabolic effects of extended exercise. During endurance activities, the body not only burns energy from glycogen and fat but also begins to use amino acids from muscle tissue when energy stores run low, leading to muscle degradation over time. A high-protein diet, like the one emphasized by the Dukan Diet, helps mitigate this breakdown by providing the necessary amino acids to preserve lean muscle mass and promote tissue repair (McAlister, 2020). For endurance athletes, maintaining muscle mass is critical not only for performance but also for long-term health and injury prevention. Protein plays a fundamental role in muscle repair, helping to rebuild muscle fibers that are damaged during strenuous exercise (Kopeć & Zawistowski, 2025). This is especially important in sports like

marathon running, cycling, and swimming, where repetitive muscle contractions over long periods can lead to microtears in the muscle tissue. By ensuring adequate protein intake, athletes can support muscle repair processes and accelerate recovery after endurance events, reducing the risk of overuse injuries (Wyka et al., 2015).

In addition to muscle preservation, protein loading also supports post-exercise recovery, a vital aspect for athletes who need to perform consistently over time. After an endurance workout, muscle glycogen stores are often depleted, and while carbohydrate intake is essential for replenishing these stores, protein plays a complementary role. Studies suggest that consuming protein alongside carbohydrates after exercise can enhance glycogen synthesis, speeding up the recovery process and preparing muscles for subsequent training sessions or competitions (Altashina et al., 2020). The high protein intake prescribed by the Dukan Diet ensures that athletes have a steady supply of amino acids available to facilitate both muscle repair and glycogen replenishment. Moreover, protein has a thermogenic effect, meaning that it increases the body's metabolic rate and can aid in fat oxidation, which is particularly beneficial for endurance athletes (McAlister, 2020). This metabolic boost can help athletes maintain a lean body composition, crucial for optimal performance in endurance sports where excess body fat can hinder efficiency and stamina. However, there are potential drawbacks to excessive protein loading, particularly when it comes at the expense of adequate carbohydrate intake. Carbohydrates are the primary fuel source for high-intensity efforts, and without sufficient glycogen stores, athletes may struggle with performance during critical moments of endurance events that require power and speed. Therefore, while protein loading is beneficial for muscle preservation and recovery, it must be carefully balanced with the body's overall energy needs, especially in the context of carbohydrate-restricted diets like the Dukan Diet (Kusmy et al., 2024).

Carbohydrate Restriction and High-Intensity Performance Trade-offs

Carbohydrate restriction is a core feature of the Dukan Diet, which emphasizes protein intake while limiting carbohydrates to induce ketosis, where fat becomes the body's primary energy source. While this metabolic shift can benefit endurance athletes by promoting fat oxidation and preserving glycogen stores, it presents significant trade-offs when it comes to high-intensity performance (Pietrzak et al., 2023). Carbohydrates, stored as glycogen in muscles and the liver, are the body's most efficient fuel source for short bursts of high-intensity activity. During intense efforts, such as sprinting, climbing, or sudden accelerations in sports like cycling, soccer, or track events, the body relies heavily on glycogen because fat metabolism cannot provide energy rapidly enough to meet the demands of explosive movements. In this context, athletes on a low-carbohydrate diet may experience reduced power output, delayed reaction times, and a drop in peak performance (Taylor, 2015).

Glycogen depletion, often experienced in carbohydrate-restricted diets like the Dukan Diet, can leave athletes struggling during critical moments of high-intensity exertion (Altashina et al., 2020). Without sufficient glycogen stores, their muscles may fatigue more quickly, leading to diminished performance in competitions that require sustained power and speed (Wyka et al., 2015). This is particularly problematic in sports where athletes need to perform well over varied intensities, such as triathlons or team sports, where endurance is important but bursts of power are equally critical to success. The initial adaptation phase of low-carbohydrate diets can be accompanied by symptoms such as fatigue, lethargy, and brain fog as the body transitions from carbohydrate-based energy to fat metabolism (Kopeć & Zawistowski, 2025). This can impact training intensity and performance until full adaptation to fat utilization occurs, which may take weeks. For athletes who require frequent high-intensity training sessions, this adaptation period could negatively affect their overall preparedness for competitions (Bracci et al., 2022). The Dukan Diet's carbohydrate restriction may still offer benefits in endurance sports by enhancing metabolic flexibility—allowing athletes to better switch between fat and glycogen as fuel depending on the intensity of their activity (Altashina et al., 2020). The diet's ability to conserve glycogen for critical high-intensity moments can be advantageous in ultra-endurance events, where athletes need a steady, long-lasting energy supply. Yet, this comes at a cost during activities requiring immediate bursts of power, as fat metabolism is too slow to meet the demands of high-intensity exercise (McAlister, 2020).

Long-Term Sustainability and Nutrient Balance in Athletes

The long-term sustainability of the Dukan Diet, with its focus on high protein intake and carbohydrate restriction, raises important questions for athletes, particularly those engaged in endurance sports. While the Dukan Diet may offer short-term benefits such as enhanced fat oxidation, muscle preservation, and weight management, its long-term application in competitive athletes may be challenging due to potential nutrient imbalances and the restrictive nature of the diet. Endurance athletes, who have higher energy demands and greater nutritional needs due to prolonged physical exertion, may struggle to sustain the Dukan Diet over extended periods, especially as it limits important macronutrients like carbohydrates (Tkacheva & Eliseeva, 2020).

Carbohydrates are essential not only for fuelling high-intensity performance but also for recovery, immune function, and mental focus. Prolonged carbohydrate restriction can lead to glycogen depletion, impaired recovery, and increased risk of overtraining or injury. Additionally, the strict phases of the Dukan Diet, especially the early phases, limit not only carbohydrates but also nutrient-dense food groups like fruits, whole grains, and legumes, which provide essential vitamins, minerals, and fiber. Over time, these restrictions could result in nutrient deficiencies, such as inadequate intake of B vitamins (important for energy metabolism), vitamin C (for immune health), and dietary fiber (for digestive health) (Kusmy et al., 2024).

Another concern with the long-term sustainability of the Dukan Diet is its potential impact on athletes' energy balance. Endurance athletes require a significant caloric intake to fuel long training sessions and competition (Bidaliya et al., 2021). The Dukan Diet's emphasis on protein, which is more satiating than carbohydrates, may lead to reduced overall caloric consumption, leaving athletes in an energy deficit. This energy imbalance could lead to muscle breakdown, decreased performance, and increased fatigue, particularly during periods of intense training or competition. Moreover, the

psychological burden of maintaining such a restrictive diet can also affect long-term adherence. The Dukan Diet's rigid structure, especially in the earlier phases, may lead to feelings of deprivation, food monotony, and difficulty in meeting social and lifestyle needs, all of which can reduce diet compliance over time. For athletes who need consistent, reliable nutrition to support their training and recovery, these challenges could make the Dukan Diet impractical in the long run (Wyka et al., 2015). The Dukan Diet may offer some short-term advantages for fat metabolism and muscle preservation, its long-term sustainability for athletes, particularly endurance athletes, is questionable due to potential nutrient imbalances, energy deficits, and the psychological challenges of adhering to a restrictive diet. Athletes require a diverse, well-balanced diet that provides not only the right macronutrients for performance but also the micronutrients needed for recovery, immune function, and overall health. Balancing the benefits of ketosis with the broader needs of an athlete's long-term performance and health is crucial when considering the Dukan Diet as a viable strategy (McAlister, 2020).

Psychological and Practical Considerations for Competitive Athletes

The Dukan Diet, with its strict focus on high protein intake and limited carbohydrates, presents unique psychological and practical challenges for competitive athletes. Adherence to such a restrictive dietary regimen requires significant mental discipline, especially in a high-pressure environment where athletes are also managing training schedules, competition demands, and recovery (Pietrzak et al., 2023). The psychological burden of following a diet like the Dukan Diet can lead to feelings of deprivation, frustration, and stress, particularly as it restricts certain food groups, such as fruits, grains, and legumes, which are typically considered essential for balanced nutrition. For athletes, mental well-being is just as important as physical fitness in achieving peak performance. The rigid phases of the Dukan Diet, particularly its early stages, may increase the risk of disordered eating behaviors, such as obsessive food tracking or a heightened focus on weight control, which can negatively affect an athlete's psychological health (Altashina et al., 2020). This can lead to performance anxiety, burnout, or decreased motivation, especially if the diet is perceived as unsustainable or overly difficult to follow in social settings or while traveling for competitions. Maintaining such a diet while participating in team activities, travel, and shared meals can be logistically challenging and may isolate the athlete from normal social interactions, further compounding psychological stress (Pietrzak et al., 2023).

From a practical standpoint, the Dukan Diet also requires careful meal planning and consistent access to protein-rich foods, which may not always be feasible for athletes with hectic schedules or those who travel frequently for competitions (Altashina et al., 2020). Additionally, the cost and availability of lean protein sources, along with the exclusion of convenient carbohydrate-based snacks, can make it difficult for athletes to fuel properly during long training sessions or recovery periods (Wyka et al., 2015). This adds another layer of complexity to dietary management, potentially impacting performance if athletes cannot meet their energy needs efficiently. In sports where body composition is closely monitored, such as endurance running or cycling, athletes on the Dukan Diet might initially experience rapid weight loss due to carbohydrate and water restriction. However, this weight loss may not always translate into better performance and could, in fact, lead to energy deficits that hinder performance in the long run. A focus on protein at the expense of carbohydrates may impair glycogen replenishment, essential for high-intensity performance, leaving athletes feeling fatigued or under-fueled (Kusmy et al., 2024). The Dukan Diet presents significant psychological and practical challenges for competitive athletes. While it may offer some benefits in fat metabolism and muscle preservation, the rigid structure of the diet can increase mental stress, reduce social flexibility, and complicate dietary planning (Pietrzak et al., 2023). Competitive athletes must weigh these challenges carefully, balancing the diet's potential physical benefits with the need for mental well-being, social engagement, and practical nutrition management to sustain long-term success in their sport (Bracci et al., 2022).

Conclusion

The Dukan Diet, with its emphasis on ketosis and protein loading, presents both opportunities and challenges for endurance athletes. Its ability to promote fat oxidation and conserve glycogen makes it a potentially valuable strategy for ultra-endurance sports, where sustained energy is crucial. Protein loading supports muscle preservation and recovery, addressing the catabolic effects of prolonged exercise. However, the significant reduction in carbohydrates, a key energy source for high-intensity activities, poses limitations. Athletes may experience reduced power and performance during moments requiring rapid glycogen utilization. Additionally, the long-term sustainability of the diet is questionable due to potential nutrient imbalances, energy deficits, and psychological burdens associated with its restrictive nature. Competitive athletes must carefully weigh the diet's benefits against these trade-offs, particularly in sports that demand both endurance and explosive strength. The Dukan Diet, while promising, requires further research to fully understand its impact on varied athletic performance and its feasibility as a long-term nutritional strategy in competitive sports.

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