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NUTRITION FOR SUCCESSFUL CYCLING PERFORMANCE

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KEY POINTS

- Despite a shared mechanical objective (i.e., force production via pedaling), competitive cycling includes many disciplines, with a wide range of physiological demands even between events within the same discipline.
- Nutritional recommendations for cyclists should be based on their specific discipline, event, role, environmental conditions (e.g., terrain, weather, altitude), rider and team tactics, and individual factors including personal preferences and experience.
- Training adaptation, recovery, and race performance optimization should involve periodization of energy and carbohydrate intake, as well as attention to intakes of protein, micronutrients, and other valuable food components.
- Road cycling Grand Tours exemplify that a proactive approach to nutrition and practical feeding strategies can allow riders to achieve extremely high energy and carbohydrate requirements of racing, including aggressive carbohydrate intakes (90-120+ g/hour).
- Aspects of non-weight bearing exercise or common experiences within cycling (e.g., constant travel, exposure to extreme environmental conditions, low energy availability during physique manipulation) may also be associated with nutrition-related challenges, health issues, and injury risks.
- Caffeine, nitrate, sodium bicarbonate, beta-alanine, and creatine are evidence-based performance supplements relevant to select cycling events.

INTRODUCTION

The sport of cycling includes a variety of disciplines, with differences in the physiological, biomechanical, and environmental demands between events and within modalities. Race demands (Table 1) determine the anthropometric and physiological characteristics, training methods, and nutritional strategies associated with optimal competition performance (Valenzuela et al., 2026). Irrespective of discipline or specific event, nutrition is a major determinant of cycling performance, with overarching themes including supporting the energy and nutrient needs of training adaptation and recovery (Morton et al., 2026a), achieving optimal physique without compromising energy availability (Burke et al., 2026b), protecting against illness and injury (Wilson et al., 2026) and making use of evidence-based sports foods and performance supplements (Whitfield et al., 2026a). Competition nutrition support varies according to the duration of races and on-bike feeding opportunities, with the evolution of practices and the culinary nutrition strategies used to achieve them being particularly evident in professional road cycling. Because of its popularity, this Sports Science Exchange (SSE) article focuses on contemporary knowledge and practice in road cycling. For greater detail on this and other cycling disciplines, the reader is directed to the 2026 Union Cycliste Internationale (UCI) Position Statement on Nutrition for Cycling (Burke et al., 2026a) as well as the individual reviews on which it is based.

PHYSIOLOGICAL AND PERFORMANCE CHARACTERISTICS

Elite cycling performance depends on the ability to sustain exceptionally high power outputs over durations ranging from seconds to several hours. Professional male cyclists can produce around 14 W/kg for 30 s, and nearly 6 W/kg for one hour (Valenzuela et al., 2022), while female professionals achieve slightly lower but proportionally similar values (Mateo-March et al., 2022). Sprinters excel in short explosive efforts, whereas climbers and time-trial specialists dominate over longer, sustained efforts (Valenzuela et al., 2026).

Cycling success is traditionally explained by maximal aerobic power (VO^2_{max}), the ability to sustain a high percentage of VO^2_{max} over time, and cycling efficiency (Joyner & Coyle, 2008). Elite cyclists often exhibit VO^2_{max} values of 70-80 mL/kg/min and can sustain intensities near their physiological thresholds for prolonged periods. Some cyclists compensate for lower aerobic power through superior conversion of metabolic energy to mechanical power output (Valenzuela et al., 2026). Real-world racing, however, is highly variable and requires repeated bursts of intense effort above physiological steady-state. This makes anaerobic power and capacity, and recovery between surges critical, especially in sprint finishes, mountain attacks, and track cycling events (van Erp et al., 2022). Recent research highlights 'durability', or the ability to maintain high performance under fatigue, as a major determinant of cycling success, with top cyclists losing less power during long races (Leo et al., 2024).

Body composition and aerodynamics also strongly influence performance. Lighter riders perform better on climbs due to higher power to mass ratios (PMR), while larger, more powerful cyclists benefit on flat terrain and sprints (Padilla et al., 1999). Muscle mass can enhance power production but may hinder climbing if excessive, making an optimal balance essential (Mujika et al., 2016). The newer discipline of Esports cycling, involving virtual races on stationary bikes, requires riders to input verified body mass (BM) into the race software where it contributes to performance dynamics. This has led to increased focus on rider BM, and pre-race use of acute weight loss strategies similar to the weight-making techniques practiced in weight division sports (Whitfield et al., 2026b). Nevertheless, in addition to manipulating body composition to increase general PMR for racing, road cyclists may also try to acutely reduce BM for mountainous stages or races using "functional dehydration" (partial replacement of sweat losses) or low fiber intakes to temporarily induce weight loss (Jeukendrup et al., 2026).

TRAINING CHARACTERISTICS

Professional cyclists follow carefully structured training programs to develop the physiological capacities required for elite racing (Valenzuela et al., 2026). Although scientific evidence on optimal training methods is limited, observational studies show that road cyclists mostly train at intensities around 65% of ventilatory threshold, with smaller portions at moderate and high intensities (Sperlich et al., 2023). Weekly training volumes for world-class riders preparing for Grand Tours usually range between 15 and 22 hours, with periodization of the volume and intensity of sessions. The use of strength training, heat acclimatization and altitude camps differ between individual riders (Gallo et al., 2022, 2023). Female cyclists generally complete lower training volumes than male counterparts, though relative training stress may be similar, and is evolving with the continual growth of women's professional cycling (Valenzuela et al., 2026).

DEMANDS OF PROFESSIONAL ROAD CYCLING RACES

WorldTour cyclists typically race 40-80 days each year, replacing the annual ~100 days of racing from previous eras. Modern professional teams now prepare their riders for key events by periodizing recovery and targeted training, including periods of altitude training and BM/body composition management, within the annual calendar. Professional cycling races, especially the three-week Grand Tours like the Tour de France, represent some of the highest sustained energy demands in endurance sport. Cyclists may expend 6,000-8,600 kcal/day over 21 stages (Westerterp et al., 1986), with mountain stages requiring the greatest energy output. Despite these extreme demands, elite cyclists maintain remarkably high power outputs, averaging around 3-4 W/kg across entire races (Muriel et al., 2022). Performance varies by stage type: time trials require the highest sustained power, while flat stages are generally less demanding (Sanders & Heijboer, 2019). Female cyclists show similar relative physiological demands as males, though races are shorter (Areta et al., 2024; Sanders et al., 2019).

Although cyclists spend most race time at low-to-moderate intensities (Padilla et al., 2001, Sanders et al., 2019), decisive race moments usually involve short, high-intensity efforts such as sprints, climbs, or attacks. Success is therefore not determined by average power alone but by the ability to repeatedly produce intense efforts after many hours of racing (Leo et al., 2021). Races in other cycling disciplines also involve highly variable and repeated maximal efforts with different requirements for technical and handling skills, or different terrain and race environments (e.g., indoors vs outdoors) (Table 1). Elite cyclists distinguish themselves by maintaining high power outputs even late in races or during consecutive stages, highlighting the importance of endurance, recovery, and effective fueling strategies.

NUTRITION FOR ADAPTATION AND RECOVERY

Energy intake (EI) is a cornerstone of nutrition, with key themes being sufficient EI during scenarios of high-energy expenditure and targeted periods of EI manipulation to optimize body composition. Given the changing training and racing loads, both energy and carbohydrate intake should be periodized to achieve "fuel for the work required" (Impey et al., 2018). Adequate protein intake is also important for promoting training adaptation, supporting recovery, and preserving muscle mass, with intakes in the range of 1.6-2.1 g/kg being appropriate for most riders (Morton et al., 2026b). Intakes toward the upper end of this range are recommended during particularly arduous training periods, and/or when riders are attempting to reduce BM while maintaining lean mass (Witard et al., 2025).

There is considerable interest in food-derived compounds such as tart cherry juice, omega-3 fatty acids, and vitamins proposed to facilitate recovery through influencing inflammation, immune function, muscle repair and sleep (Morton et al., 2026b). Since exercise-induced oxidative stress and inflammation play important signaling roles in adaptation processes, the use of nutraceuticals and functional foods should be considered within a periodized framework. While targeted use of supplemental forms may be useful for periods of intensified training or competition where rapid recovery is required, more conservative use, relying on food forms, may be warranted during training phases where the primary goal is to maximize adaptation.

RACE STRATEGIES AND THE CULINARY NUTRITION TEAM

Carbohydrate and energy needs vary according to race demands (Table 1). There are various practical and alimentary challenges to consuming very high EI during stage races. Useful aspects of the culture and logistics of road cycling include the capacity to achieve high on-bike intakes when food/drink supplies are provided (Jeukendrup et al., 2026), as well as activities undertaken by the Culinary Nutrition Teams (chefs/dietitians). Many professional teams provide a plentiful food environment with menu choices that are portable, energy-dense, and easy to consume (Lis & Strobel, 2026). Expert advice may be needed to assist riders to understand the range in energy requirements associated with racing, and to develop eating practices/choices that are suited to their specific needs.

Pre-race nutrition should address the specific fuel and fluid challenges created by the event. For long races and stages, this means restoring muscle and liver glycogen, supporting total daily EI and beginning the race with a hydration state appropriate to the expected environment, and drinking opportunities. Simple carbohydrate-loading protocols of 1-2 days at ~10-12 g/kg/day can maximize glycogen stores for events where this is relevant (Burke et al., 2017; Fuchs et al., 2025). The pre-race meal, typically 1-4 g/kg carbohydrate in the hours before racing, should then be individualized according to duration, intensity and gut comfort. Post-race eating should address recovery of fuel stores, repair and adaptation, and is particularly important during stage races (Jeukendrup et al., 2026)

Professional cycling has developed sophisticated culinary nutrition activities to translate evidence-based nutritional goals into food environments: portable meals, high-carbohydrate snacks, familiar menus, safe food handling, recovery stations and individualized choices (Lis & Strobel, 2026). This matters because high energy targets are only possible if riders can consume them repeatedly, enjoy them sufficiently, and tolerate them under stress. Culinary support is also central during travel, where disrupted routines, food availability, hygiene, time zones, and appetite changes can undermine nutrition plans (Cheung et al., 2026).

ON BIKE NUTRITION SUPPORT

A striking recent development in professional road racing is the dramatic increase in carbohydrate intake. Despite earlier reports of in-race carbohydrate intakes of ~94 g/h during the Tour de France (Saris et al., 1989), observational data from the late 1990s reported average on-bike intakes of approximately 23 g/h during Grand Tours (García-Rovés et al., 1998). By the late 2000s, however, values around 60 g/h had become common, and contemporary WorldTour cyclists now frequently target carbohydrate intakes of 90-120 g/h, with even higher amounts reported during the most demanding stages (Jeukendrup et al., 2026). The strategies and opportunities to fuel aggressively during races (see below) reflect unique characteristics of cycling such as relatively few gut problems, event culture, and race rules (Jeukendrup et al., 2026).

This shift reflects improved understanding of intestinal carbohydrate absorption and exogenous carbohydrate oxidation. Glucose-only feeding is limited by intestinal transporter capacity, whereas glucose-fructose combinations make use of multiple intestinal uptake systems and enhance total carbohydrate absorption and oxidation (Jentjens & Jeukendrup, 2005). Better delivery of exogenous fuel is associated with reduced gastrointestinal discomfort and superior performance outcomes (Jeukendrup et al., 2026). Carbohydrate intake during prolonged exercise achieves performance benefits via a number of mechanisms including direct contributions to muscle substrate use, sparing of liver glycogen and perhaps muscle glycogen, prevention of hypoglycemia, and interaction between oral receptors and the central nervous system (Morton et al., 2026a; Rollo et al., 2020). Although emerging dose-response studies are yet to identify the optimal rates of carbohydrate intake in such scenarios (elite cyclists working at high absolute work rates for prolonged periods), it is noted that intakes >120 g/h may also be beneficial to contribute to the high daily carbohydrate and energy targets.

MANAGING PHYSIQUE, ILLNESS, AND INJURY

Cyclists face several overlapping risks: high training volumes, physique pressure, low-impact loading, travel, environmental exposure, repeated racing and large nutrient demands. Chronic low energy availability associated with manipulation of BM/body fat can contribute to Relative Energy Deficiency in Sport (REDs), with negative consequences for endocrine function, metabolism, immune defense, bone health and performance (Mountjoy et al., 2023). Cyclists should seek expert advice on targets and strategies for BM management (Burke et al., 2026a).

Bone health receives special emphasis because cycling is non-weight-bearing and may provide a limited osteogenic stimulus. Low energy and low carbohydrate availability, calcium and vitamin D inadequacy, menstrual dysfunction, and heavy training can converge to create a 'perfect storm' for skeletal health (Saffioti et al., 2026). Therefore, bone health should be considered in day-to-day fueling decisions and physique management rather than only in long-term injury rehabilitation.

Illness and injury prevention are also dependent on robust nutrition. Adequate energy, carbohydrate, protein, micronutrients, and dietary diversity support immune function, while targeted use of polyphenols, probiotics or other functional foods may have a role during intensified training, travel or competition blocks. Gastrointestinal symptoms require a similar balance between preparation and personalization. Gut training, planned carbohydrate forms, fiber periodization, and careful use of supplements can reduce symptoms without unnecessarily restricting the habitual diet (Jeukendrup, 2017; Wilson et al., 2026).

PERFORMANCE SUPPLEMENTS

Most widely used performance supplements are not supported by meaningful and event-specific evidence of efficacy/effectiveness. The UCI Sports Nutrition Project recognized caffeine, creatine, bicarbonate, β-alanine, nitrate/beetroot juice, and glycerol (Group A of the Australian Institute of Sports (AIS) Sports Supplements Framework) to have proof of benefits, when used according to specific protocols in specific scenarios. Exogenous ketone supplements (Group B, AIS Sports Supplements Framework) have received considerable attention in cycling but have limited support for a defined use. Although all may have potential application to cycling, two questions should be answered: "Does this supplement solve a performance limitation in this rider, in this specific event?" and "Can a well-practiced protocol be implemented in training or racing to achieve performance goals, using a product that is batch tested to reduce the risk of an anti-doping rule violation?" For more information on sports foods and supplements in cycling see Whitfield et al. (2026a) and Jeukendrup et al. (2026).

SUMMARY

Cycling, via its variety of disciplines and events, showcases a range of demands and opportunities for nutrition to enhance rider health, training adaptation, and race performance. A number of strategies to support nutrition goals can be aligned with the rider and event. Road cycling demonstrates the extremes of energy and carbohydrate expenditure in cycling and the creative ways in which nutrition goals can be met.

Cycling Discipline/ Subdisciplines	Typical Event Characteristics	Key Physiological Determinants	Special Considerations	Primary Nutrition Priorities
Road Cycling	Single races from <1 h (time trials) to 10 h over courses ranging from flat to mountainous Stage races of 2-10 d Grand Tours (males) of 3 w	High aerobic power, ability to sustain repeated surges, recovery between stages, high PMR	Environmental extremes (altitude and weather), altitude training common, BM manipulation to increase PMR including acute strategies before mountain stages	Periodization of energy and CHO needs including periods of high requirement, aggressive on-bike fueling, hydration, rapid post-stage recovery, acute and chronic BM management
Gravel Cycling	Single races of 1.5-10+ h over mixed-terrain	Sustained power output, technical riding skills, fatigue resistance	Limited external support during races; riders often need to carry all nutrition	High carbohydrate availability, portable fueling strategies, hydration planning
Track Sprint	30-90 s events with multiple rounds	Neuromuscular power, ATP-PC and glycolytic capacity	No opportunity for in-race feeding	High carbohydrate availability, recovery between rounds, hydration management
Track Endurance	4 to 60 min events; multiple races per session	Aerobic power, anaerobic capacity, pacing ability	Thermal strain inside velodromes	Pre-race carbohydrate loading, between-race refuelling, hydration
BMX Racing	30-40 s maximal efforts repeated throughout the day	Explosive power, repeat sprint ability, technical skills	Frequently conducted in hot outdoor environments	Carbohydrate feeding between races, hydration maintenance
Mountain Bike Cross-Country	80 min to multi-day stage races	High aerobic power, repeated severe-intensity efforts, technical handling skills	Additional energy cost from technical riding and vibration damping	Pre- and during race carbohydrate intake, hydration, recovery nutrition
Mountain Bike Downhill/ Enduro	Short maximal descents with long transition periods	Technical proficiency, reaction speed, upper-body strength	Nutrition opportunities often limited to transition phases	Pre-event carbohydrate intake, hydration, strategic fueling during transitions
Cyclo-cross	50-60 min high-intensity racing	Sustained severe-intensity effort, technical skills, repeated accelerations	Limited feeding opportunities during competition	Pre-race carbohydrate loading, caffeine, hydration
Esports Cycling	<1 h high-intensity virtual racing Single race and multiple race formats	Sustained PMR, repeated surges, thermal tolerance	Acute weight making before race weight check, heat stress of indoor racing environment	Acute and chronic BM management, pre-race fueling, in race hydration and carbohydrate support

Table 1. Characteristics of disciplines and their key events within the sport of cycling.
s, seconds; h, hour; d, days; w, weeks; PMR, power to mass ratio; BM, body mass; CHO, carbohydrate; ATP, adenosine triphosphate; PC, phosphocreatine.

Factor	Comments	Recommendations
Feeding Opportunities	• Race rules, feed zones, terrain, and tactical demands influence opportunities to access and consume foods and drinks • Riders can carry own supplies on bike or in jersey pockets and receive additional support from soigneurs in feed zones, team cars, or other riders (domestiques)	• Align nutrition plans with course profile and feeding opportunities • Prioritize intake during low-risk race segments, considering tactical and technical demands
Carbohydrate Targets	• Performance benefits increase with carbohydrate availability and ingestion rate, particularly during events >2.5 h	• <2.5 h: 30-60 g/h • >2.5 h: 90-120 g/h, higher intakes are increasingly observed in WorldTour races
Carbohydrate Source	• Multiple transportable carbohydrates increase absorption and oxidation rates	• At intakes >60 g/h, use glucose-fructose combinations via sports products (drinks, gels, bars, etc.) • "Everyday foods" (rice cakes, sandwiches, fruit, etc.) may contribute to total carbohydrate intake, providing taste variety and increased nutrient range according to rider preference
Fluid Considerations	• Sweat rates vary according to workload and environment (~0.6-2.0 L/h) • During mountainous stages, partial replacement of sweat losses may achieve a loss of BM to increase PMR but may also increase perceived effort and reduce performance	• Individualized hydration plans should aim to minimize excessive dehydration • Monitoring BM changes during racing or training in hot environments may provide feedback about sweat rates and success in managing these • Make individualized decisions about whether "functional dehydration" is useful or harmful during mountainous stages
Gut Tolerance	• Gastrointestinal tolerance can be improved through repeated exposure to high carbohydrate intakes	• Incorporate gut-training sessions into race preparation • Individualize feeding strategies according to tolerance
Acute Body Mass Management	• Low-residue diets can reduce BM without substantial glycogen or fluid depletion	• Consider short-term, low-fiber diets to reduce BM before key climbing stages or races • Periodize the use of such approaches, remembering the gut benefits and greater nutrient density associated with diets richer in fiber
Recovery Integration	• On-bike intake contributes substantially to total daily energy and carbohydrate targets	• View race nutrition as part of a 24-h recovery-fueling strategy rather than an isolated performance intervention

Table 2. Practical applications: on-bike nutrition support in road cycling.

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