



UCI Sports Nutrition Project: Position Statement on Nutrition for Cycling

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Nutrition is a key determinant of cycling performance, underpinning the ability to optimize on-bike performance, support training adaptation and recovery, and maintain rider health and well-being. While these goals are shared across disciplines, the diverse physiological demands and logistical constraints of different cycling disciplines present distinct nutritional challenges. In recognition of both the importance of nutrition and the diverse individual and discipline-specific demands of cycling, the Union Cycliste Internationale Sports Nutrition Project was established and led by a steering committee that synthesized the expertise of 54 researchers to identify key nutritional requirements for elite cycling and develop recommendations that account for both individual and discipline-specific needs. These insights were published within a series of 14 topic-specific reviews. In this position statement, we present the principal take-home messages from the overall project, organized into 10 overarching themes spanning performance preparation, in-competition fueling, recovery and adaptation, energy availability, physique management, protecting against illness and injury, technological support, the use of supplements and sports foods, and age- and sex-specific considerations. Cycling-specific considerations are used to develop targeted nutritional recommendations within each of these themes, and high-priority future research directions are identified.

Keywords: endurance athletes, macronutrients, ergogenic aids, energy availability, performance

In addition to its role in recreational and transportational activities, cycling includes a range of competitive sports, with the Union Cycliste Internationale (UCI) being the international governing body of 11 established cycling disciplines (road, track, mountain bike, BMX freestyle, BMX racing, indoor cycling, trials, cyclo-cross, gravel, cycling Esports, and snow bike) as well as paracycling. The UCI's activities of competition oversight and support for rider health and safety encompass a recognition of the key role of nutrition across a variety of themes. These include awareness that, despite the extreme range in the characteristics between and within these disciplines, the training and racing workloads undertaken by cyclists can impose major challenges to requirements for energy, carbohydrate (CHO), protein, fluid, and micronutrients. Across events, cyclists share common goals that are nutrient-demanding: to train as effectively as possible with optimal adaptation and recovery and to race at their best on the day(s) of competition. However, the nature (e.g., nonweight-bearing activity) or common experiences (e.g., exposure to extreme environmental conditions or body composition manipulation) of cycling may also be associated with nutrition-related challenges, health issues, and injury risks. Cycling races range in duration from seconds to weeks, with various physiological limitations to performance that may be addressed by a variety of nutrition strategies undertaken pre-, during, or between events. The evidence-based use of sports foods and supplements may contribute to the achievement of training and race nutrition plans, as can the information provided by technology. Performance eating challenges may also need to be addressed by finding practical solutions to eating on the bike, negotiating frequent travel, and managing extreme energy needs or food intolerances.

Recognizing the uniqueness and importance of the diverse nutritional demands across different cycling disciplines, the UCI has supported the development of a position statement to

summarize contemporary understandings of nutrition for high-performance cyclists. These recommendations are underpinned by the evidence and insights provided in a companion series of reviews of the key cycling disciplines (Haakonssen et al., 2026; Jeukendrup et al., 2026; Oosthuyse et al., 2026; Stanley et al., 2026; Whitfield, Mujika, & Burke, 2026) and common issues arising across cycling (Burke et al., 2026; Cheung et al., 2026; Gonzalez et al., 2026; Lis & Strobel, 2026; Morton, Hearnis, et al., 2026; Saffioti et al., 2026; Valenzuela et al., 2026; Whitfield, Egan, et al., 2026; Wilson et al., 2026). Indeed, the process of development of this position statement commenced with collaboration between an organizing committee (Burke, Dolan, Gonzalez, Mujika, and Whitfield) and a key representative from UCI (Bigard) to divide topical nutrition-related issues within its cycling disciplines into 14 themes. Thereafter, various practitioners and sports medicine/science researchers from within cycling disciplines, or from special themes were invited to contribute to narrative reviews on these topics. Each was separately peer-reviewed under the supervision of the *International Journal of Sport Nutrition and Exercise Metabolism* editorial board for publication as companion material. This position statement, representing a summary of each paper, was then compiled by the organizing committee before being reviewed and endorsed by contributing authors from the themed papers, and finally by the UCI representative (Bigard).

Although the recommendations in this position statement are particularly targeted to the elite levels of competitive cycling, they may also have relevance to the many millions of cyclists who compete at lower tiers. Since the needs of paracycling are more specialized, they have not been included in the current project, and readers are referred to specific reviews for such information (Flueck, 2021). In addition to presenting the key needs of cyclists and current information on how they should be addressed, this statement identifies areas for future research that are considered high priority.

Theme 1: Understanding Key Events Within Cycling Disciplines

Although the fundamental requirements of all cycling disciplines are the same, namely, the requirement to generate the force needed to propel the bike forward via pedaling, physiological demands, and in turn nutritional requirements vary widely both within and between disciplines. Cycling events range from just a few seconds of all-out effort (e.g., track sprints and BMX racing) to several weeks of sustained competition (e.g., 3-week Grand Tours in road cycling). Even within a given discipline, physiological demands can differ substantially. For example, a road cyclist specialized in climbing or sprinting exhibits very different physiological requirements than a rider targeting the general classification. In turn, nutritional recommendations and strategies must be tailored to these diverse demands.

A companion review to this position statement (Valenzuela et al., 2026) has outlined the principal factors that underpin cycling performance including event characteristics (e.g., track vs. road and single-day vs. multistage race); extrinsic race conditions (e.g., race profile, weather conditions, altitude, and team tactics); and individual factors (e.g., mental, physical, physiological, and technical attributes and nutritional strategies). Table 1 summarizes key characteristics and primary nutritional goals across cycling disciplines, with further detail provided in accompanying papers in this series, including articles focused on road cycling (Jeukendrup et al., 2026), sprint and endurance track cycling (Stanley et al., 2026), bicycle motocross or BMX racing (Haakonssen et al., 2026), mountain biking and cyclo-cross (Oosthuyse et al., 2026), and new and emerging cycling disciplines including Esports and gravel (Whitfield, Mujika, & Burke, 2026).

Theme 2: Supporting Training, Adaptation, and Recovery

Energy Needs in Training and Competition

Energy intake (EI) is a cornerstone of nutrition in all cycling disciplines, with key themes being the consumption of sufficient

dietary energy during periods of high energy expenditure (EE) and the manipulation of EI to achieve optimal body composition (Theme 5). The biggest contributors to total daily energy requirements are resting metabolic rate and physical activity EE. The latter is typically divided into exercise expenditure, that is, the planned and structured activities designed to optimize cycling performance (exercise EE), and nonexercise activity thermogenesis, which encompasses all other occupational and daily physical activities. Exercise expenditure is the most variable component between and within cyclists, due to the fluctuation of training and racing workloads (Burke et al., 2026). In some disciplines, cyclists undertake intensified training periods or stage races (e.g., the Grand Tours) in which expenditures equivalent to five to six times resting metabolic rate are maintained for several weeks (Jeukendrup et al., 2026). Even where cycling modes allow reasonably accurate information about EE to be gained from power meters or other technologies to guide energy requirements there are various practical and alimentary challenges to consuming very high EI. As identified in Table 1, useful aspects of the culture and logistics of cycling include the capacity in many disciplines/events to achieve high on-bike intakes when food/drink supplies are provided (Jeukendrup et al., 2026), as well as the culinary nutrition activities undertaken by many professional cycling teams to provide a plentiful food environment with menu choices that are portable, energy-dense, and easy to consume (Theme 7; Lis & Strobel, 2026). Expert advice may be needed to assist riders to understand the range in energy requirements associated with various periods of training and racing and to develop eating practices/choices that are suited to their specific needs. As further outlined in Theme 5, early recognition and attention to periods of inadequate EI, whether deliberate or unintentional, is important in reducing the risk of problematic energy mismatches. The contribution of nonexercise activity thermogenesis to the total energy requirements of cyclists is underexplored, but habitually low or high amounts of recreational or lifestyle activity may need to be factored into total energy needs (see Table 2).

Nutrition Strategies to Promote Training Adaptation

Training adaptation is broadly defined as the integrated structural and functional changes that occur in response to training, which reduce the physiological strain associated with that workload, hence enhancing capacity to perform it (Morton, Hearnis, et al., 2026). Historically, cycling nutrition primarily emphasized preparatory on-bike and recovery fueling strategies. Contemporary approaches recognize, however, that nutrition also plays a fundamental role in determining the adaptive responses to training and that nutritional strategies should therefore be aligned with the specific goals of a session. The “fuel for the work required” paradigm provides a practical framework to target nutritional strategies according to the training goal (Impey et al., 2018). Ensuring adequate energy and CHO availability is fundamental to sustaining training intensity and volume and is particularly relevant when preparing for more intense and prolonged sessions, or during competition when performance optimization is the goal (see Themes 3 and 4). It is increasingly recognized, however, that nutrient availability is not only a performance determinant but is also a key modulator of cell signaling pathways involved in the regulation of training adaptation (Philp et al., 2012). Of particular relevance to cycling is evidence that training with reduced CHO availability can augment signaling responses associated with mitochondrial biogenesis and oxidative adaptations and, as such, may

THEME 1 KEY POINTS AND SUPPORTING PAPERS WITHIN THE UCI SPORTS NUTRITION PROJECT SERIES

- Despite a shared mechanical objective, namely force production via pedaling, physiological demands both within and between cycling disciplines vary widely, meaning that there is no single “optimal” nutrition model for cycling.
- Targeted nutritional recommendations should be developed based on discipline, event, and role-specific demands, alongside consideration of environmental conditions (e.g., terrain, weather, and altitude), team/tactical demands, and individual factors including physiological capacity and personal preferences.

Source: Haakonssen et al. (2026), Jeukendrup et al. (2026), Oosthuyse et al. (2026), Stanley et al. (2026), Valenzuela et al. (2026), Whitfield et al. (2026).

Table 1 Summary of Key Characteristics and Primary Nutritional Goals Across Cycling Disciplines

Cycling discipline	Sex	Subdiscipline	Event	Typical duration	Other features	Performance requirements	Key nutritional issues
Road	M	Grand Tour (20–21 days, 2 rest days)	Flat stages	150–220 km, 4–5 hr	<2,000 m elevation gain	• Key performance factors vary according to stage characteristics, team role, and tactics	• Fueling and hydration during stage
			Semimountainous	150–220 km, 5–6 hr	>2,000 m elevation gain		• Refueling, rehydration, and recovery between stages critical
			Mountainous	150–200 km, 5–6 hr	>3,000 m elevation gain		• Requirement to address wide-range of environmental conditions across race (e.g., changes in temperature, altitude, etc.)
	M	Multiday stage races	Time trials	<60 km, <1 hr	<1,000 m elevation gain	• Common issue: capacity to achieve intermittent and/or sustained high-power outputs at critical points of race	• Additional focus required to meet overall energy requirements during Grand Tours including the special support of culinary nutrition teams
	F	Multiday stage races	2–10 days	150–240 km, 5–6 hr	As above re: terrain/format, noting that races for females are shorter in duration than those for male road cyclists, with stage races also involving fewer days	• Recovery between stages essential for sustained performance	• Periodization of nutritional strategies to meet changing goals over the race duration
Gravel			2–8 days	100–150 km, 3–5 hr		• Increased awareness of acid-base disturbances during high-intensity efforts	• Mounting stages: BM manipulation including low-residue diet
	M	Single day	Road race	~200–300 km, 5–7 hr		• As above but with greater capacity to focus on specific race needs	• Use of evidence-based supplements including recent increased interest in use of buffering agents
	F	Single day	Road race	~125–175 km, 4–6 hr			• As above but with greater opportunity to focus on specific prerace fueling and on-bike strategies
	M	Single day	Time trial	35–45 km, <1 hr	May be flat or hilly	• Sustained high-power event with focus on aerodynamic considerations	• Limited need/opportunity for on-bike intake; focus on prerace strategies (hydration, fueling, cooling, and supplements)
	F	Single day	Time trial	30–40 km, <50 min		• Rough surfaces and reduced drafting require sustained high-power outputs across multiple hours	• Unique rules across races dictate the availability and necessity of aid stations to restock/refuel. In some instances, riders may opt to forgo stopping to attain an advantage over competitors
	M/F	Single day		50–300+ km, 1.5–10+ hr	Terrain, altitude, and exposure vary within and across races	• Course profile may necessitate higher intensity starts based on bottlenecks (e.g., single-track trail heads) or mixed-gender starts	• Remote nature and race regulations may limit outside assistance forcing riders to be self-sufficient and carry all required fuels/liquids. Novel solutions include use of hydration packs and race suits with additional pockets and/or integrated storage for hydration bladders
						• Bike handling skill requirements may be greater due to mixed-terrain surfaces	

(continued)

Table 1 (continued)

Cycling discipline	Sex	Subdiscipline	Event	Typical duration	Other features	Performance requirements	Key nutritional issues
Esports cycling	M/F	Single day	Virtual racing	Typically < 1 hr	Course profile varies and may emphasize climbing, sprinting, or time-trial skill requirements	Extremely high sustained power outputs ($>7 \text{ W}\cdot\text{kg}^{-1}$) and capacity to repeatedly generate high-power outputs during sprints ($>11 \text{ W}\cdot\text{kg}^{-1}$)	Immediately prior to each race, Esports cyclists are required to input (and verify) BM data into the virtual race software where it contributes to performance dynamics based on PMR ratios. This has led to increased focus on rider BM and use of acute weight loss strategies similar to weight-making techniques practiced by athletes in weight division sports
	M/F	Multiple stages, may be completed on a single day (i.e., rounds) or across several days	Virtual racing	Typically < 1 hr	Course profile varies, and may emphasize climbing, sprinting, or time-trial skill requirements	“Gamification” may impact tactics and strategy based on “power-ups” used in some platforms (e.g., short-term decreases in BM or increased aerodynamics of virtual rider) or by awarding points for fastest time for specific segments rather than first finisher, etc.	- Riders may be exposed to increased thermal strain due to decreased convective cooling, in combination with potential risk of dehydration due to weigh-in procedures. - While access to fueling and rehydration is not limited, races tend to be short and are punctuated by high-intensity bursts with little recovery/free-wheeling, which may preclude nutrition intake
Track cycling	M/F	Sprint	Team sprint	~40 s (M) and ~45 s (F)	Three riders competing across multiple rounds with (1–8-hr recovery between rounds)	- Performance requirements vary based on position (e.g., fast starter vs. fast finisher) - Common physiological traits include extremely high neuromuscular power and anaerobic (e.g., ATP-PC and glycolytic) power production alongside technical ability to execute changeovers	- Preevent fueling prioritizing high CHO availability - Postrace recovery emphasizing CHO and protein - No intrarace fluid intake possible; development of a hydration plan pre- and postrace is required due to multiple races and environmental conditions inherent to velodromes
	M/F	Sprint	Match sprint	~50 s	Tactical match racing over 750 m	- Peak power - Anaerobic power - Tactical nous	- CHO intake prior to and in between races supports repeated efforts and cognition - Balance protein versus CHO - Emphasis on hydration requirements due to multiple races and environmental conditions inherent to velodromes
	M/F	Sprint	Keirin	~90 s	Multiple rounds of a 1.5-km race, composed of motor-bike paced opening 750 m increasing from 30 to 50 $\text{km}\cdot\text{h}^{-1}$ followed by 750 m of tactical bunch racing	- High anaerobic capacity - Tactical nous	- High CHO intake to fuel for repeated rounds - Emphasis on hydration requirements between heats due to multiple races and environmental conditions inherent to velodromes

(continued)

Table 1 (continued)

Cycling discipline	Sex	Subdiscipline	Event	Typical duration	Other features	Performance requirements	Key nutritional issues
	M/F	Endurance	Individual pursuit	~240–270 s (M), ~260–280 s (F)	Solo time trial competed over multiple rounds Air density has considerable influence on speed/times Environmental conditions of indoor velodrome influence thermoregulation	• High aerobic and glycolytic power production • Pacing of effort	• Emphasis on high CHO intake prior to and following competition • Strategic intake of CHO between rounds necessary in order to promote recovery/refueling • Hydration intake prioritized before racing
	M/F	Endurance	Team pursuit	~220–240 s (M), ~245–260 s (F)	Team time trial competed over multiple rounds Air density has considerable influence on speed/times Environmental conditions of indoor velodrome influence thermoregulation	• High aerobic and glycolytic power production • Pacing of effort	• High CHO intake to fuel for repeated rounds • Emphasis on hydration requirements between heats due to multiple races
	M/F	Endurance	Madison	~50–55 min (M), ~45–50 min (F)	Tag-team event characterized by stochastic efforts Environmental conditions of indoor velodrome influence thermoregulation	• Sustained aerobic power production with anaerobic bursts • Ability to recover when intermittently tagged “out” of the race • Tactical nous	• High CHO demand, critical to consider timing of pre- and post-race fueling • No intrarace fluid intake possible; development of a hydration plan pre- and post-race is required • Opportunities to use hydration strategies for thermoregulation
	M/F	Endurance	Omnium	2–3 hr total	Combination of four events; scratch (9–10 min), tempo (8–10 min), elimination (~12 min), and points race (~25–28 min) 30–60 min recovery between events Environmental conditions of indoor velodrome influence thermoregulation	• Mixed aerobic/anaerobic energy contribution • Tactical nous	• High CHO demand • Repeated CHO replenishment (i.e., snacks/fluids) between events • Opportunities to use hydration strategies for thermoregulation
BMX	M/F	BMX	BMX race	~30–40 s	Up to seven races per day competed on a 300- to 450-m track featuring jumps and turns requiring intermittent sprints and technical riding Races commence with a 8-m start hill with positioning at the first turn critical Often competed in hot outdoor environment	• Maximal neuromuscular power • High ATP-PC and glycolytic energy production • Repeat sprint ability • Technical and tactical nous • Upper and lower body strength	• High CHO availability prioritized, with between-race CHO feeding • Hydration managed across a day (aiming for <2% BM loss) • Opportunities to use hydration strategies for thermoregulation

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Table 1 (continued)

Cycling discipline	Sex	Subdiscipline	Event	Typical duration	Other features	Performance requirements	Key nutritional issues
Mountain biking	M/F	DHI	Single-timed DHI run	≤3.5 km, ~2–5 min	Individual timed run on a DHI course featuring ~500 m elevation loss on a narrow path/single track Courses feature a steep gradient, varying uneven surface conditions (fine sand, mud, rocky, and exposed roots) and large natural or built obstacles/jumps	• Quick reaction time • Maximal effort • Superior technical riding skills • Capacity to manage high vibrational accelerations and muscular absorbance of high landing forces • Upper body and core engagement/strength for bike handling	• No nutrition is required on the bike • Multiple practice runs and a qualifying run in the days preceding the main event require ongoing planned prepractice and recovery standard nutrition and hydration • Preamble race event CHO and low-dose caffeine
	M/F	Enduro	Multiple timed DHI runs plus transitions	3–6 × 2–8 min timed stages plus untimed transitions, total time of 4–6 hr (~40–70 km)	Courses feature ~1,600 m total elevation gain, 2,000–2,800 m total elevation loss The timed descents portions are similar to DHI courses only with moderately smaller obstacles/jumps The untimed transitions (climb to the next timed stage) on dirt roads have a time limit	Timed descents: • Same as for DHI Untimed transitions: • Low- to moderate-intensity climbing	• Standard 24 hr pre-race nutrition • No nutrition is required/possible during timed DHI stages • Hydration, CHO ingestion, and timing of any supplements (e.g., caffeine) are important during untimed transitions • Standard recovery CHO and protein
	M/F	XCC	Short circuit racing	20 min, ~8–10 km (6–8 laps)	Mass start races on 1–2 km circuit, mostly with minimal elevation gain. Courses feature a mixture of surfaces (sand and grass) and can include mud when wet Only a few small obstacles/jumps, rocks, or roots, however feature single track and sharp turns and berms with the start/finish on wider track/road Athletes pass through a feed zone every lap Late-afternoon start times are common	• High-paced, maximal effort • Capacity to maintain prolonged efforts above critical power/metabolic steady state • Superior bike handling	• Standard 24 hr pre-race nutrition • No nutrition is required during racing, but CHO mouth rinsing may provide benefits • Use of buffering agents (e.g., sodium bicarbonate) beneficial, but consideration should be made re: possible fluid retention and BM gain that may be detrimental for the subsequent XCO event (performed ~48 hr later) • Use of pre-race caffeine is beneficial but with late starting times could impair sleep • Recovery nutrition including CHO and protein must be prioritized in preparation for the subsequent XCO event (performed ~48 hr later)
	M/F	XCO	Short circuit racing	80–100 min, ~24–30 km (five to seven laps)	Mass start races on 3.5–6 km circuit featuring ~1,000 m total elevation gain Courses are much more technical than XCC, with root or rock covered sections, steep drops, and bigger obstacles/jumps Wet muddy conditions increase rolling resistance and technical demand	• High pace that includes severe-maximal intensities • High capacity for frequent intermittent severe-maximal efforts with limited recovery • Technical aspects of the descents preclude recovery • Superior bike handling skills • Vibrational dampening and bike handling strength and energy provision • A high PMR	• Standard pre-race CHO and low-dose caffeine • Continual hydration and CHO supplementation in the lap-feeding zone is imperative • The technical nature of the circuit otherwise limits fluid or nutrient intake • Standard post-race CHO and protein recovery nutrition should be followed • Recommendation that total energy intake should include an additional +24 kcal·kg⁻¹·km⁻¹ off-road to compensate for the added energy cost of isometric contractions associated with vibrational dampening and bike handling

(continued)

Table 1 (continued)

Cycling discipline	Sex	Subdiscipline	Event	Typical duration	Other features	Performance requirements	Key nutritional issues
	M/F	XCM	Single-day, long continuous route	60–150 km, 3–7 hr	Mass start races typically competed on a looped course with 1,600–3,000-m elevation gain. Most courses include a mix of gravel road, jeep track, and single track. Surface conditions and obstacles can be the same as for XCO but only occur intermittently. A starting altitude above 1,500 m with sections of the route >2,000 m above sea level is common. Typically, three to four feed zones.	• Moderate-high pace to be maintained • Favors excellent climbers with high PMR • Time can be saved with superior technical and descending skills • Smart nutritional planning is imperative for success • Altitude acclimation is a benefit for high altitude-based races • Tolerance to a high rate of CHO ingestion during exercise	• 24 hr and prerace high CHO intake and low dose caffeine • Consistent hydration and high (60–90 g·hr⁻¹) CHO ingestion during racing • Top up caffeine in the latter stages as required • Postrace recovery CHO and protein, and compensation of daily energy intake with an additional 24 kcal·kg⁻¹·km⁻¹ off-road due to the energy cost of isometric contractions as explained for XCO • The use of polyphenol compound supplements the day(s) before, and prerace is gaining support
	M/F	Cross-country stage racing	4–9 days, long continuous routes	4–9 days × 50–150 km, 3–7 hr	Typically a team event (two riders) featuring ~1,200–3,000-m elevation gain, where the daily courses are like XCM but may include one shorter “prologue” or time-trial stage. The start and finish locations can be different for each stage, with each stage having a cutoff time.	• The same requirements as for XCM • Capacity to maintain daily performances with limited overnight recovery • Good team dynamic regarding pacing that is sustainable for both riders • Rigorous nutrition on and off the bike of each member determines the performance of the team • Conducive sleeping conditions	As for XCM with extra emphasis on: • Maximizing the rate of CHO intake during racing • Protein hydrolysate ingestion pre/during racing has some support • Recovery nutrition is a priority with prolonged periods of CHO (1.2 g·kg⁻¹, 4–6 hr) and protein ingestion (~0.3 g·kg⁻¹, 2 hr) at recommended doses • Consider the use of polyphenol compound supplements daily prestage/and in recovery
Cyclo-cross	M/F		Short-circuit racing	50 min (F) to 60 min (M)	Mass start races completed on a 3-m wide path across a 2.5–3.5-km circuit. Courses feature a mixture of surfaces (e.g., tarmac, dirt/mud, and grass) where mud and high rolling resistance is common. Courses feature ≤6 nonnatural obstacles, such as planks, ascending steps, and sandpits requiring dismounting and carrying the bike. No feed zones; riders must carry all their hydration/nutrition.	• High-paced severe to maximal intensity mostly above critical power/maximal steady state • Quick dismounting, bike portage, and remounting skills • Excellent skills for riding and running in mud and rain	• Emphasis on 24 hr prerace high CHO and low-dose caffeine 1 hr prerace • Ingesting fluids and CHO during racing are beneficial but with limited opportunity • Standard posttrace recovery nutrition applies

Note. M = male; F = female; BM = body mass; PMR = power-to-mass ratio; CHO = carbohydrate; DHI = downhill; PC = phosphocreatine; XCC = cross-country short track; XCO = cross-country Olympic; XCM = cross-country marathon.

Table 2 Summary of Key Nutritional Recommendations During Training

Nutritional recommendation		Key points and supporting papers within the UCI Sports Nutrition Project Series
EA Strive for habitual energy availability of approximately 40–45 kcal·kg FFM ⁻¹ ·day ⁻¹ (EA = EI – EEE)/FFM		• Cyclists should aim for the upper or lower levels of this recommended range based on their overall activity level outside of structured cycling training. The lower end may be suited to those with low levels of NEAT/recreational activity while the higher end provides energy support for higher overall activity levels • The total EI required to meet these EA targets may vary widely given that EEE can be extremely high, particularly during intensive training periods or competition, with total intakes of up to 7,000–9,000 kcal·day⁻¹ potentially required during some competition scenarios (e.g., road and cross-country multiday stage racing) • Cyclists should strive to habitually meet EA goals, while recognizing that this may be challenging during heavy training periods or competition. Short periods of planned, periodized low EA are unlikely to be problematic if ample recovery time follows, and the cyclist maintains habitual energy adequacy in the long term
		• CHO availability is defined by the match between acute CHO intake and the fuel needs of training/racing. Since CHO is the primary metabolizable fuel used to support higher intensity cycling, high CHO availability (intake = fuel demands) supports optimal training and race performance but may not be necessary for all sessions • In addition to potentially impacting training quality, adequate CHO availability may have an important role in supporting other essential functions including bone metabolism and immune function • Strategic inclusion of “train-low” sessions (e.g., low muscle glycogen and overnight-fasted conditions) within a periodized training program may amplify training adaptations. This may involve brief periods of restricted/reduced CHO intake around targeted sessions • Total CHO intake is provided by daily meal choices but also by fueling strategies undertaken on-bike and pre/postsessions. In many cycling disciplines, substantial on-bike intake is possible, with training sessions providing an opportunity to contribute to total daily fuel goals as well as to practice (“gut training”) intended race nutrition strategies • During intensified training or multiday racing, postsession CHO intake contributes to total daily CHO needs and early intake may assist recovery by maximizing effective refueling periods
CHO Intake should be adapted to training and racing demands, which vary between disciplines/events and within the rider’s periodized program. Total daily needs during periods of optimized training/racing are often provided as suggested ranges but should be individualized according to each rider’s total nutrition goals and experiences: Light endurance: 5–7 g·kg ⁻¹ Track cycling: 3–8 g·kg ⁻¹ Moderate endurance (<3 hr·day ⁻¹): 6–10 g·kg ⁻¹ Intensified training (>4 hr·day ⁻¹): >8 g·kg ⁻¹ Extreme racing (>6-hr single races and stage events): 10–25 g·kg ⁻¹ according to the specific rider and event		• Adequate protein intake is essential to support musculoskeletal adaptation and recovery, especially through periods of intensified training/racing • Protein intake also supports other important biological processes, including bone metabolism and immune function • Intakes toward the upper end of this recommended range are advisable if the cyclist is in a period of low-energy or CHO availability or to promote recovery on rest days following strenuous training • Strategies to distribute protein at each meal and during/postexercise or prior to sleep assist with the achievement of total protein intake goals • Although animal-derived proteins are higher in digestibility and in essential amino acids and amino acid balance, plant-derived proteins and eating styles can be accommodated by strategies that increase total protein intake and/or use protein blends to balance amino acid intake
Protein 1.6–2.1 g·kg ⁻¹ ·day ⁻¹ , ideally spread across the day		• Fats are an important source of energy due to their high energy density • Daily fat targets may often be inversely proportional to CHO requirement. On days with high CHO requirements, proportionally lower fat may be required to reduce GI distress, whereas higher fat intakes on lower training or rest days may be important to meeting overall energy needs • Adequate fat intake is required to facilitate absorption of fat-soluble nutrients, including vitamins A, D, E and K, as well as to provide essential fatty acids including the omega-3 fatty acids (e.g., EPA/DHA), all of which have important functions in supporting overall health and metabolism, including key roles in supporting immune function and bone health • Vitamins, minerals, polyphenols, and other food components play important roles in health, immunity, and oxidant/inflammatory control • Calcium and vitamin D are key micronutrients of interest for bone health (see Theme 6) and may require supplementation in some scenarios (see Theme 9) • Iron status should be monitored periodically and supported by iron-rich eating strategies. At times, iron supplementation (100–200 mg·day⁻¹) may be required to treat/prevent deficiency or to support optimal hematological adaptations to altitude training • At special times (e.g., intensified training or racing), the use of special functional foods or concentrates may be justified to provide the benefits of antioxidant or anti-inflammatory support. However, the balance with blunting training adaptations should be considered
Fats ~20%–35% of total energy intake		
Micronutrients A varied menu based on nutrient-dense food choices is the cornerstone of the cyclist’s diet		

Note. Sources: Burke et al. (2026), Morton et al. (2026). EA = energy availability; EI = energy intake; EEE = exercise energy expenditure; FFM = fat-free mass; NEAT = nonexercise activity thermogenesis; CHO = carbohydrate; GI = gastrointestinal.

represent an important strategy within the overall training and nutrition plan. The extensive review by Morton et al. (2026) accompanying this series summarizes the cycling-focused literature on the various “train low models” (e.g., twice per day training, fasted training, sleep low, and recover low), explaining the various stimuli and identifying a variety of subcellular responses of both transient signaling and protein content (Morton, Hearnis, et al., 2026).

It is important to note, however, that evidence that such acute/short-term changes lead to enhanced performance outcomes is currently limited. Indeed, care must be taken to ensure that intentional training under low CHO availability does not compromise the quality of key training sessions, nor should it come at the expense of maintaining habitually adequate energy availability (see Theme 5). With this in mind, contemporary nutrition practices tend to emphasize the strategic manipulation of energy and CHO availability on a meal-by-meal and day-by-day basis, the ultimate aim being to strategically balance competing objectives, namely, the promotion of specific adaptive responses, the optimization of training quality, and maintenance of athlete health. This approach underpins the concept of nutritional periodization, whereby energy, macronutrient, and micronutrient availability are deliberately manipulated across microcycles, mesocycles, and macrocycles to promote training adaptation, support recovery, and manipulate body composition and ultimately competition performance (Morton, Hearnis, et al., 2026). The accompanying review presents examples of how such periodization might be implemented in programs typically undertaken by cyclists. Here, it is also noted that the high training loads undertaken by cyclists often lead to CHO requirements during “high CHO availability” phases that are larger than typically seen in most sports nutrition guidelines (Thomas et al., 2016) and that practice of on-bike fueling strategies can prepare for race nutrition plans as well as contribute to total daily targets (Morton, Hearnis, et al., 2026).

Protein Requirements

Protein intake also plays a central role in supporting training adaptation, providing the amino acids required for muscle protein synthesis and acting as a signal for tissue remodeling. Increased requirements for cyclists are due to its use as an energy substrate for heavy workloads and increased rates of protein breakdown and resynthesis during postexercise recovery, with a further increase during periods of lower energy or CHO availability (for review, see Morton, Hearnis, et al., 2026). Current evidence supports a habitual intake of $\sim 1.6\text{--}2.1\text{ g}\cdot\text{kg}^{-1}$ distributed across the day (Morton, Hearnis, et al., 2026), with intakes toward the upper end of this recommendation likely beneficial during periods when training with low CHO availability (Gillen et al., 2019) or energy restriction for body composition manipulation (Witard et al., 2025). Although evidence that efforts to optimize the timing and distribution of protein over the day lead to enhanced long-term benefits is equivocal, there is still sense in motivated cyclists targeting substantial intakes at each meal, as well as during/after exercise and prior to sleep, if only as a practical strategy to ensure that daily targets are met (Morton, Hearnis, et al., 2026). The higher digestibility and balanced/essential amino acid content of animal-derived proteins is acknowledged (Pinckaers et al., 2021). Nevertheless, plant-based proteins and vegetarian eating styles can be included in cycling nutrition as long as strategies such as increasing total intake and using protein blends to balance amino acid content are used to compensate for these differences

(Pinckaers et al., 2023). In practice, it can be challenging to achieve recommended protein intakes on days when very high CHO intakes are required to support prolonged or intense training. As such, higher protein meals may be emphasized on recovery days to support adaptation and ensure habitual intakes within recommended ranges (Lis & Strobel, 2026).

Nutrition for Recovery

While training provides the stimulus for adaptation, the recovery period is key to determining the extent and nature of the adaptive response. As such, nutrition strategies to support effective recovery between sessions are key. As described above, protein is a key nutrient required to support the repair and remodeling of skeletal muscle and other tissues. Sleep is a critical, yet often overlooked, component of the recovery process (Halson, 2019). There is increasing recognition of a bidirectional relationship between nutrition and sleep, whereby habitual dietary patterns may influence sleep quality and, conversely, poor sleep may alter food choice and EI (Zuraikat et al., 2021). Diets with higher intake of fiber, lean protein, fruit, and vegetables and lower saturated fat content tend to be associated with better sleep (Wilson et al., 2022). Furthermore, various multi-ingredient sleep supplements are available, which typically combine ingredients with purported effects on melatonin synthesis, neurotransmitter regulation, or relaxation. Evidence for their efficacy in controlled laboratory settings is currently mixed, although positive effects on sleep latency and efficiency have been reported in free-living environments (Langan-Evans et al., 2023). Their use may therefore be best suited to higher stress environments, such as training camps or competition, where habitual sleep patterns are disrupted.

There is also considerable interest in nutraceuticals and functional foods to support recovery and adaptation. Food-derived or enhanced products, such as tart cherry juice, omega-3 fatty acids, and vitamins are proposed to facilitate recovery through influencing inflammation, immune function, muscle repair, and sleep (Morton, Hearnis, et al., 2026). It is important to consider, however, that exercise-induced oxidative stress and inflammation play important signaling roles in processes underpinning adaptation. Accordingly, the use of nutraceuticals and functional foods should be considered within a periodized framework, with targeted use of supplemental forms reserved for periods of intensified training or competition where rapid recovery is required. More conservative use may be warranted during training phases where the primary goal is to maximize adaptation. Nevertheless, nutrient-rich menus that supply food forms of these constituents for both recovery and long-term training provide a sustainable and effective balance that places further value on the role of the culinary nutrition team (CNT).

Theme 3: Preparing to Race

Nutritional strategies undertaken in the day(s)/hours prior to a race can assist the cyclist to address some of the factors that are important for performance. As outlined in Table 1, these factors will vary between cycling disciplines and events according to the specific race features and requirements for success, as well as the event schedules. While some disciplines feature one-off races in which preevent strategies can be optimized, others feature multiday competitions (e.g., road cycling and cross-country stage races) or multiple events within the same day (e.g., BMX racing and track cycling) in which the priorities of race preparation also include (but

sometimes fail to complete) recovery from the prior event. In some events, the opportunity for significant in-race fueling contributes more fully to race nutrition support and may overcome prerace deficits. Nevertheless, adequate fueling and hydration status are common interests in prerace plans but must be achieved according to the event logistics and gastrointestinal (GI) comfort. In some events, acute body mass (BM) manipulation may be undertaken to optimize power-to-mass ratios (PMR).

“Fuel for the work required” is a consistent theme in cycling nutrition (Morton, Hearris, et al., 2026) and the specific fueling strategies undertaken in race preparation for the various disciplines/events (Haakonssen et al., 2026; Jeukendrup et al., 2026; Oosthuysen et al., 2026; Stanley et al., 2026; Whitfield, Mujika, & Burke, 2026). In single-day events where maximal muscle glycogen contribution to race fuel is important, stores can be optimized in well-trained individuals (Greiwe et al., 1999) by “CHO loading” protocols as simple as 1–2 days of very high CHO intakes: $10\text{--}12\text{ g}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ with additional allowances for CHO use during any training sessions performed on these days (Burke et al., 2017). Such aggressive CHO intakes can also maximize liver glycogen stores (Fuchs et al., 2025). During multiday road and cross-country races, there is a constant cycle of recovery after each stage to prepare for the next, with daily CHO and EI being periodized within the race and between riders according to their work requirements, terrain, and team role/tactics (Jeukendrup et al., 2026; Oosthuysen et al., 2026). As shown in Table 1, preparation for shorter cycling events can generally be achieved with more moderate fueling practices (e.g., $4\text{--}8\text{ g}\cdot\text{kg}^{-1}\cdot\text{day}^{-1}$ CHO; Haakonssen et al., 2026; Stanley et al., 2026).

The prerace meal provides another opportunity to top up muscle and liver glycogen stores and, in the case of extreme competition, such as stage races, contribute to total energy and CHO demands for the day as well as recovery for the next. Typically, CHO-rich meals providing $1\text{--}4\text{ g}\cdot\text{kg}^{-1}$ BM span the range of fuel needs for shorter events (e.g., track, BMX, and cyclo-cross; see Table 1) to the longer races (e.g., lengthy gravel, cross-country, and road races; Table 1). Riders who experience GI problems during races may experiment with reducing their intake of foods/nutrients that can exacerbate such problems in the meal/days prior to competition (see Theme 6). Fluid intake in the prerace period should consider race conditions and the likelihood of significant dehydration within the race or over a series of races. In most situations, the cyclist would aim to commence a race in a euhydrated condition, with a range of tools (e.g., day-to-day changes in BM or urinary characteristics) assisting in detecting acute shifts in body water to guide fluid needs beyond thirst (Cheung et al., 2026). Theme 7 notes special tactics that might be helpful in very hot conditions, in which thermal characteristics of prerace fluids may contribute to the race plan.

In some events/conditions, however, a small degree of dehydration may be tolerated and may allow the cyclist to reduce BM, in the belief that a higher PMR will enhance performance. Strategic dehydration prior to the race may occur involving an uphill or hilly terrain in single races or time trials. The calculated risk that the benefits of a reduction in BM will “outweigh” any negative effects of a fluid deficit on perception of effort or actual performance needs to take into account the experiences of the cyclists and the characteristics of the event (e.g., duration, course profile, and environmental conditions). However, the inclusion of cycling Esports as a recognized UCI discipline, with an official requirement to “weigh-in” (and in some instances provide a urine sample for urine specific gravity assessment) prior to a race, has created a more

transparent role of BM in cycling performance. Caution is therefore needed to prevent the culture and practices of “weight making” (Burke et al., 2021) seen in weight division events such as combat sports from becoming entrenched. Indeed, the potential for performance impairments in response to some popular weight-making strategies (i.e., deliberate dehydration) may be exacerbated by some aspects of the Esports cycling format (e.g., reduced convection; Whitfield, Mujika, & Burke, 2026).

One potential strategy to reduce prerace BM is the temporary implementation of a low-residue diet, in which athletes reduce dietary fiber intake in the race build-up, focusing on consuming more energy-dense, compact foods, which reduce GI content and BM, but without inducing a substantial energy deficit or dehydration (Mancin et al., 2025). This strategy has been reported to induce statistically significant, albeit modest, weight loss of approximately $0.74\% \pm 0.99\%$ BM (Foo et al., 2022). It is typically implemented over a 48–72 hr period (Burke et al., 2019) and can be a practical tool to temporarily increase PMR, but without the performance risks of fluid and fuel depletion. In stage races, it may be used strategically within the race nutrition plan to achieve a targeted reduction in BM just before a mountainous section (Table 1). It should not, however, be used chronically, considering the importance of ensuring adequate fiber content in the habitual diet (Mancin et al., 2025).

Theme 4: On the Bike Nutrition

Cycling is a unique sport in relation to nutritional support during races (and the accompanying training sessions). Many cycling disciplines/events present both the need and opportunity to consume energy, CHO, and fluid on-bike (Table 1). Lengthy race duration and stage racing increase the benefits of specific provision of exogenous fuel, and in the latter scenario, the intake of energy across the day. Factors that assist on-bike intake include a reduced risk of GI discomfort compared with “jostling” sports such as running (Peters et al., 1993) and the relative ease of carrying and consuming race supplies. Professional road cycling, in particular, has developed both practical solutions and a culture that promote in-race nutrition supported by CNT resources; collaborations between teams, sports food companies, and the technology industry; race rules that support feeding opportunities (e.g., the provision of *musette* bags or fluid *bidons* from feed zones or team cars); and media publicity about rider practices. Indeed, a significant increase in energy and CHO intake has occurred in stage racing over the past decade (Jeukendrup et al., 2026). Feeding ease is not universal across all races, nor all longer cycling events, however. For example, aggressive riding tactics in road races or Esports cycling, technical considerations in the demanding terrain of mountain bike or cyclo-cross, and a reduced team support or direct race rules in some gravel events all contribute to a reduced opportunity for in-race nutrition (Table 1). Furthermore, GI discomfort might limit intake in riders with preexisting gut issues (ter Steege et al., 2012; ter Steege & Kolkman, 2012), when riding at high intensities in an aerodynamic riding position that increases abdominal pressure (de Oliveira et al., 2014), and if sustained EIs during stage tours are above the suggested alimentary limit (Thurber et al., 2019). Therefore, sports nutrition support should be developed according to a personalized and practiced plan suited to the event and the rider. Specific considerations regarding CHO and fuel intake are discussed in the accompanying paper by Jeukendrup et al. (2026), noting that fueling practices can contribute significantly to total EI for the high energy demands of stage racing.

CHO Intake

All cycling disciplines involve exercise with intensities in which CHO are an important fuel. The consumption of CHO during a race can enhance performance through a variety of mechanisms including direct contributions to muscle substrate use, sparing of liver, and perhaps muscle glycogen, prevention of hypoglycemia, and interaction between oral receptors and the central nervous system (Jeukendrup et al., 1999; Karelis et al., 2010; Rollo et al., 2020; Rothschild et al., 2026). The amount of CHO ingested on the bike is important, and the mechanisms by which it provides benefits vary according to a range of factors including the duration and intensity of the race (Table 1). Mouth rinsing effects of CHO on pacing and perceived effort may play a role in shorter (40–60 min) races (e.g., time trials, cyclo-cross, and Esport races), as long as the effort required to implement this strategy is not onerous (Brietzke et al., 2019a, 2019b). Longer races in disciplines such as road cycling, cyclo-cross, and gravel benefit from the metabolic role of ingested CHO, with recommendations ranging from 30–60 to 90 g·hr⁻¹ (or even higher in highly trained riders) as the race duration and workload increase (Table 3). With higher amounts of CHO intake (>60 g·hr⁻¹), there is a greater requirement for strategies that enhance GI absorption and tolerance (Jeukendrup et al., 2026). This includes the use of specialized sports foods/drinks containing “multiple transportable CHO” (mixtures of glucose- and fructose-based CHO), which are absorbed in the intestine by different transport proteins, and thus allow the effective delivery and oxidation of higher rates of exogenous fuel (Jeukendrup, 2010). Training the gut, via a targeted program to consume increasingly larger amounts of CHO during training sessions particularly with intended race nutrition supplies, achieves physiological changes to increase gut absorption, tolerance, oxidation, and benefits of these products (Jeukendrup, 2017). Across all disciplines, CHO intake plans should be adjusted based on factors such as the event workload, rider goals, environmental characteristics, and personal preferences (Jeukendrup et al., 2026; Oosthuyse et al., 2026; Whitfield, Mujika, & Burke, 2026).

At the time of preparation of this statement, there was much interest but few research activities into field observations of professional cyclists and other elite athletes consuming higher hourly rates of CHO (120 g and even above) during the most grueling 1-day and stage races (Morton, Fell, et al., 2026). Although such targets can be achieved with combinations of CHO-containing sports drinks/foods and everyday foods (Whitfield, Egan, et al., 2026), further investigations are needed to determine whether such practices are associated with systematic performance benefits. Of course, the potential for an increased risk of GI problems must be acknowledged, as well as the possibility that benefits are indirect (e.g., contribution to extreme energy demands or enhanced recovery).

Hydration

Dehydration can reduce cycling performance, depending on the individual, the environment, the presence of thirst, and the race characteristics (Cheung et al., 2026; Jeukendrup et al., 2026). Although there is debate about the threshold of fluid deficit at which detriments occur, a general aim to maintain net losses below 2% BM seems both prudent and feasible for many cycling events or disciplines (Cheung et al., 2026; Jeukendrup et al., 2026). Sweat rates are determined by factors such as workload intensity, environmental conditions, convective cooling, and heat acclimatization status, with some of the features that increase sweat rates

coinciding in various cycling events. For example, sustained high workloads in time trials and stochastic higher intensity efforts in longer races often occur with reduced convective airflow due to aerodynamic riding positions and bunch drafting. Furthermore, in some events, riders deliberately dehydrate before or during the event to improve their PMR for a perceived advantage due to terrain (e.g., hill climbing) or technological requirements (e.g., the inclusion of preevent BM in esport cycling performance calculations; Jeukendrup et al., 2026; Whitfield, Mujika, & Burke, 2026). Here, the perceived advantages may not actually occur if the reduction in BM is counteracted by reduced performance due to the fluid deficit (Ebert et al., 2007).

As is the case for CHO, many longer cycling events offer the potential for on-bike fluid intake in volumes that can maintain the net fluid deficit at acceptable levels (Jeukendrup et al., 2026; Oosthuyse et al., 2026; Whitfield, Mujika, & Burke, 2026). Monitoring BM changes during training sessions with similar characteristics can provide a gauge for likely sweat rates, while monitoring pre- to postrace BM changes can assess the success of fluid intake behavior and the need to develop/tweak a fluid plan. While *ad libitum* drinking practices may be sufficient in some scenarios, in others, a more targeted approach that integrates CHO intake goals provides value. Race rules that govern access to nutrition support/feed zones, the overlay of technical/tactical challenges to drinking, and the avoidance of GI discomfort also need to be considered in this plan. While drink *bidons*, carried by the rider and/or swapped at feed zones are the typical vehicle for managing fluid supplies, in events requiring self-sufficiency, fluid bladders integrated into race suits and/or hydration packs provide an alternative fluid source. In shorter disciplines/events, fluid plans focus more on rehydration between races, noting that such events often occur in hot environments (Haakonssen et al., 2026; Stanley et al., 2026). Theme 7 covers strategies to target increased hydration and cooling requirements for cycling in hot conditions.

Theme 5: Managing Physique and Energy Issues

Physique management is a key concern for cyclists, although the specifics of how that physique manifests depend on the modality in question, the cyclist's specific role or specialty within that modality, and their individual characteristics and genetics. For example, BMX riders tend to be larger and more muscular than either mountain bike or road cyclists (Haakonssen et al., 2026), while road cyclists who specialize in hill climbs often strive to be lighter than those who specialize in points classification (Padilla et al., 1999; Sanchez-Munoz et al., 2023). Within the boundaries of their own genetic makeup, each rider's physique will be shaped by the interplay between training and nutrition, and appropriate dietary strategies are key to supporting riders to meet their physique goals.

Both total energy and protein intake are particularly relevant in optimizing a cyclist's physique. Lean muscle mass is the driver of pedaling force, and regardless of the rider's target BM, maintaining a high muscle-to-fat ratio is generally advantageous as it ensures that as much of the rider's BM as possible contributes to force production (Mujika et al., 2016). As described by Morton, Hearnis, et al. (2026), adequate protein intake is key to promoting training adaptation, supporting recovery and preserving muscle mass. In turn, cyclists generally require protein intakes in excess of the general population's recommended dietary allowance of 0.8 g·kg⁻¹·day⁻¹, with intakes in the range of 1.6–2.1 g·kg⁻¹·day⁻¹

Table 3 Summary of Key Nutritional Recommendations Before, During, and Between Races

Nutritional recommendation	Key points and supporting papers within the UCI Sports Nutrition Project Series
<i>Prerace preparation</i> CHO: 1–4 g·kg⁻¹ BM in the 1–4 hr prerace Fluid intake to achieve hydration goals according to event	• Fuel requirements vary according to the specific race and the rider's goals, as well as the connection to a larger nutrition plan/race schedule • Larger CHO-rich meals are suited for races with high energy and fueling requirements, particularly when the rider needs to refuel from a previous race or overnight fast • Smaller CHO intake may be more suited to races with smaller fuel demands, especially when the daily timetable/race schedule means it is eaten closer to race start • Planned fluid intake may be useful if the rider needs to overcome a fluid deficit from a previous race/session or intentional dehydration prior to export cycling weigh-in • Preparation for races in hot environments where thermoregulation and/or fluid deficits are likely challenges may include hyperhydration (assisted by glycerol or sodium loads) and/or precooling including the intake of ice slurries
On-bike intake <i>CHO intake scaled to race duration</i> • 40–75 min: mouth rinsing according to practicalities and perceived benefits • 1–2.5 hr: 30–60 g·hr⁻¹ • >2.5 hr: 90 g·hr⁻¹ • Intakes of 120 g·hr⁻¹ or even higher in professional cyclists are noted but require validation of benefits <i>Fluid intake guidelines</i> Fluid intake to maintain net fluid deficit <2% BM, especially in hot conditions According to sweat rates and event characteristics, strategies may range from ad libitum intake to a fluid plan	• Longer cycling events offer event-specific opportunities to consume food and fluids during the race. Each rider should develop and continually evolve a race nutrition plan that uses their unique opportunities to obtain and ingest CHO and fluid according to their performance needs • In shorter events, the central nervous system benefits of CHO mouth sensing may provide a pacing/effort benefit, as long as it can be practically achieved during the race. Benefits are seen with 5–10 s contact between a CHO choice (sports drink, gel, etc.) and the oral cavity and may be repeated during racing or undertaken just before a critical piece • A range of CHO-rich foods and drinks—both sports products and everyday choices—can be used to meet the targets of 30–60 g·hr⁻¹ for shorter endurance races. According to the race scenario, they may need to be carried by the rider or accessed from feed zones • When CHO intakes >60 g·hr⁻¹ are targeted, the rider should make use of specialized sports products, which provide multiple transportable CHO (glucose + fructose based) to allow greater intestinal absorption via use of different transport mechanisms • Fluid intake plans should be made according to anticipated sweat losses (modeled from training/race experiences), opportunities to access and drink fluid supplies, and the importance of hydration goals (e.g., weather conditions, likely distraction of thirst). On some occasions, it may be sufficient to drink when convenient/thirsty, but when large sweat losses are anticipated or demonstrated via large pre- to posttrace BM changes, a more focused plan should be developed/tweaked. This may require greater use of existing drinking opportunities/access to fluid supplies or creative tactics to circumvent the current limits • Gut tolerance of fluid and CHO intake plans is critical for their success. This can be improved, especially when aiming for aggressive targets, by “gut training.” This involves deliberate practice with gradually increasing amounts of intended race supplies to increase gut absorption and comfort
<i>Targeted recovery between stages/races</i> Immediate recovery goals 1–1.2 g·kg⁻¹·hr⁻¹ CHO 0.3–0.4+ g·kg⁻¹ protein Fluid intake of 125%–150% postexercise fluid deficit may be required over next 4–6 hr Electrolyte/sodium replacement in recovery fluids or in meals consumed at same time	• Although daily recovery is important during training periods, many cycling disciplines involve competition formats with multiple races, within day or over several days, including extended duration stage races (e.g., Grand Tours). According to the event, there may be benefits in maximizing or promoting early rates of refueling, rehydration, and repair between events • Between race refueling can be maximized by CHO intake of 1–1.2 g·kg⁻¹·hr⁻¹, beginning soon after a race to commence effective glycogen synthesis until resumption of general meal practices that meet total fuel needs • Repair/protein synthesis may also be supported by early intake of protein • Rehydration after a significant fluid deficit (>2% BM) may be aided by planned fluid and electrolyte replacement. It may require a fluid volume of 125%–150% of the deficit to restore large fluid losses over 4–6 hr recovery • Replacement of sweat electrolyte losses, particularly focusing on sodium, is required to restore plasma volume by enhancing retention of ingested fluids. This can be achieved through the use of formulated electrolyte replacement products (~50–80 mM sodium) or by the inclusion of salt-rich foods or salted meals in recovery eating plans • Recovery menus should focus on foods/drinks that are practical and available, especially to accommodate other posttrace activities. They should also consider gastrointestinal tolerance, noting that the rider may have a suppressed appetite after a race or may need to consider comfort for an upcoming race

Note. Sources: Haakonssen et al. (2026), Jeukendrup et al. (2026), Oosthuysen et al. (2026), Stanley et al. (2026), Valenzuela et al. (2026), Whitfield et al. (2026). CHO = carbohydrate; BM = body mass.

likely appropriate for most riders (Morton, Hearnis, et al., 2026). Intakes toward the upper end of this range are recommended during particularly arduous training periods, and/or when riders are attempting to reduce BM.

In some situations (e.g., mountain or hill-climb stages of a road race or for indoor racing formats such as Esports), it may be advantageous for riders to reduce their BM to optimize their PMR. PMR, which reflects a rider's capacity to generate power relative to BM, is an important performance indicator particularly when climbing or accelerating. Even small reductions in BM can meaningfully improve PMR and, in turn, cycling speed, although care should be taken to ensure that this does not come at the cost of optimizing CHO availability (Jeukendrup et al., 2026). Furthermore, short-term energy deficits with concomitant training may also promote skeletal muscle training adaptations (Nishimura et al., 2025). As such, there may be benefits to planning periodized training and nutritional programs that facilitate riders to be at peak

performance and their lightest BM at key competition times, as well as to promote specific metabolic adaptations (Stellingwerff et al., 2019).

While planned, targeted BM reduction can yield performance benefits; overemphasizing BM loss or calorie restriction is not recommended and it can be difficult for many riders to maintain racing BM all year round. Cyclists are considered to be a group with high risk of low energy availability (LEA; Burke et al., 2026), which is defined as insufficient energy to meet basic biological processes after the demands of training have been met (Loucks et al., 2011). Chronic or prolonged LEA can lead to wide-ranging deleterious health and performance-related outcomes, as described in the *Relative Energy Deficiency in Sports* (REDs) model (Mountjoy et al., 2023). As described in Theme 2, many cyclists have very high energy demands at least during some periods, due to the volume and intensity of training. Meeting these energy demands can be challenging, not only due to the logistics of preparing and delivering the volume of food required, but also due to GI limits to tolerate and process very frequent or large meals. Pairing this challenge with intentional dietary restriction can dramatically increase the potential for riders to experience adverse health and performance-related consequences, as discussed in detail in another article in this series (Burke et al., 2026). To mitigate this, it is important to cultivate a healthy and informed culture regarding body composition and mass, avoiding over-emphasis on leanness and excessive calorie restriction. Regular screening for indicators of relative energy deficiency in sports risk using the REDs Clinical Assessment Tool Version 2 may also be useful for early detection of potentially at-risk riders (Stellingwerff et al., 2023). Beyond energy availability, the coexistence of a range of other stressors with potential to influence symptoms often attributed to LEA should also be considered (Jeukendrup et al., 2024).

THEME 5 KEY POINTS AND SUPPORTING PAPERS WITHIN THE UCI SPORTS NUTRITION PROJECT SERIES

- Physique management is a key consideration for cyclists, many of whom must balance the high-energy demands of training and competition with nutritional strategies that support the physique most conducive to optimal performance.
- Individual strategies should consider body mass as a metric rather than a goal and adopt flexible body mass ranges that are periodized across the training and racing season rather than fixed targets.
- Riders should prioritize fueling strategies to ensure adequate energy availability, such that habitual intake is sufficient to meet training demands, in addition to all other essential physiological processes.
- While brief, planned, and periodized periods of low energy availability may be strategically used to support specific training objectives, or may be unavoidable during particularly intensive training or competition phases, adequate fueling during recovery should be prioritized, considering that prolonged low energy availability exposure may result in a range of adverse health and performance consequences.
- Regular monitoring and screening should be undertaken to identify riders at risk of problematic low energy availability or eating/body image disorders so that early intervention and individualized support can reduce the prevalence of long-term negative consequences.
- Cultural change within local and global cycling organizations is important for fostering healthier approaches to physique management. Education strategies targeted at all levels of support/management as well as riders should focus on the elements of adequate fueling, recovery, and health, as well as the diverse determinants of performance. Outdated beliefs of “the lighter, the better” should be replaced by more holistic performance and health-focused messages.

Source: Burke et al. (2026).

Theme 6: Nutritional Strategies to Protect Against Illness and Injury

Managing cyclists' health is critical, considering that time lost due to illness and injury can have major performance consequences. As such, strategies to support rider health and well-being are essential to enable consistent training and optimized performance. Common health challenges faced by cyclists include recurrent upper respiratory tract infections, GI disturbances, and compromised bone health, while the most common injuries include abrasions, lacerations and hematomas, fractures, and head and musculoskeletal injuries (Fallon et al., 2025; Rooney et al., 2020). While the etiology of these issues is multifactorial, nutrition status can have an important influence. In turn, targeted nutritional strategies play an important role in supporting rider health, with implications for both performance and longer term health.

Immune Function and Illness Prevention

Upper respiratory tract infections including the common cold, influenza, and other viral infections are frequently reported among cyclists (Fallon et al., 2025), with increasing risk during periods of intensified training and competition. Susceptibility is influenced by immune competence, which can become compromised by many factors, such as high training loads; competitive demands; inadequate recovery; and environmental issues including heat, cold, and air pollution (Derman et al., 2022). Nutritional factors play an important role in determining immune competence and, in turn, in reducing infection risk (Wilson et al., 2026).

Adequate energy and CHO availability are central to supporting immune function (Gleeson, 2016; Wilson et al., 2026). Protein intake also contributes to immunoglobulin synthesis and tissue repair, with intakes in the range of 1.6–2.1 g·kg⁻¹·day⁻¹ deemed appropriate for most cyclists (Morton, Hearnis, et al., 2026). In addition, omega-3 fatty acids and micronutrients such as vitamin C, zinc, and iron play important roles in supporting immune function (Wilson et al., 2026). Vitamin D has immunomodulatory effects, and as inadequacy can compromise immune responses (He et al., 2016), regular monitoring is recommended, with supplementation via fortified foods or supplements indicated if required to correct insufficiency. Additional immune support may come from polyphenol-rich foods, which are compounds found in teas, fruits, and vegetables and exhibit anti-inflammatory and antiviral properties (Ding et al., 2018), although it is important to highlight that much of the supporting evidence comes from supplementation trials rather than from regular foods (Somerville et al., 2016; Yao et al., 2022). Probiotic supplementation has also been suggested to reduce upper respiratory tract infection risk in the general population (Zhao et al., 2022), although evidence in athletic populations remains equivocal (Heimer et al., 2022) and further research in cyclists is warranted.

GI Health

GI disturbances including bloating, cramping, and diarrhea are common among cyclists, especially during prolonged or high-intensity events. Their causes are multifactorial, with contributing factors including GI hypoperfusion during exercise, dehydration, and nutritional practices. CHO provision during longer rides can enhance performance (Jeukendrup et al., 2026; Morton, Hearnis, et al., 2026), although tolerance varies between individuals. Issues including anxiety, chronic sleep dysfunction, supplements (e.g., sodium bicarbonate or caffeine) or medication use, and GI infections may also contribute to increased GI distress risk in cyclists, particularly during arduous training periods and competition.

To reduce the likelihood of GI symptoms, nutritional strategies should be individualized and practiced during training. Attention should be given to preexercise meals to ensure tolerance. In the 1–3 hr before exercise, foods associated with slower gastric emptying (e.g., high-fat or high-protein meals) may increase the risk of symptoms in susceptible athletes. The GI tract is adaptable, and regular CHO ingestion during training, with progressive increases in intake, can enhance gastric emptying and intestinal tolerance (Jeukendrup, 2017). The use of multiple transportable CHO (e.g., glucose–fructose mixtures) may further improve CHO absorption and oxidation. Short-term (e.g., 36–48 hr, noting this varies among individuals) implementation of low-FODMAP (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) dietary strategies prior to competition may reduce GI symptoms in sensitive individuals, as well as to achieve small BM reductions (Burke et al., 2019), although chronic restriction is not recommended due to potential adverse effects on gut microbiota and overall health (Hughes & Holscher, 2021; Mancin et al., 2025).

Injuries

A recent systematic review and meta-analysis of epidemiological studies on competitive cycling injuries reported that across all studied disciplines (road, mountain bike, BMX, and noting the lack of studies on cyclo-cross, gravel, indoor trials, and Esports as well as paracycling disciplines), the most common injury types across

THEME 6 KEY POINTS AND SUPPORTING PAPERS WITHIN THE UCI SPORTS NUTRITION PROJECT SERIES

- Nutritional strategies play a central role in supporting cyclist health; maintaining immune function; reducing illness risk, and supporting recovery from training, competition, and injury. Although illness or injury may be associated with a reduced workload and lifestyle interruptions, adequate energy availability and management of sleep and stress should be considered the cornerstone of repair and recovery.
- Gastrointestinal disturbances are common in cyclists, particularly during prolonged or high-intensity sessions. These can be mitigated via individualized nutritional strategies including preexercise meal composition, gut training, and consideration of carbohydrate type and intake patterns.
- While nutrition cannot prevent traumatic injuries, it is essential to support tissue repair, connective tissue integrity, and bone health and may also have an important role in promoting postinjury recovery. Supplementation with omega-3 fatty acids and creatine may assist in the reduction of concussion severity.
- Bone health should be supported by managing energy intake to maintain adequate energy availability most of the time, noting that there may be periods of extremely high energy expenditures or targeted loss of body mass/body fat in which brief periods of exposure to LEA occurs. Carbohydrate intake should also be periodized according to fuel needs for training and racing, noting that low carbohydrate availability may mediate some of the short-term negative effects on bone turnover markers often seen during short-term energy deficits, as well as contribute to immune suppression.
- Adequate intake of calcium (800–1200 mg·day⁻¹) is important for bones, noting that there may be some benefits in preexercise calcium supplementation to attenuate the observed increase in biomarkers of bone breakdown during/after the session.
- Vitamin D status should be supported via monitoring of blood concentrations in cyclists at risk (serum 25(OH)D levels > 50 and ideally 75 nM) and combinations of sunlight exposure, dietary intake, and supplements.
- Focusing on a variety of nutrient-dense foods within training and racing diets will help to meet requirements for immune-, bone-, and injury-supporting nutrients such as protein (1.6–2.1 g·kg⁻¹·day⁻¹), zinc, magnesium, phosphorus, vitamins C and K, and essential fatty acids.

Source: Burke et al. (2026), Morton et al. (2026), Saffioti et al. (2026), Wilson et al. (2026).

all disciplines were skin lacerations, abrasions, and lesions. Bone fractures were the second most common injury type (Fallon et al., 2025). While nutrition cannot directly prevent falls or acute traumatic events, targeted nutritional strategies including ensuring adequate energy and macronutrient availability can be used to optimize tissue integrity, immune function, and healing capacity. Nutritional strategies to support immune function are also relevant in the context of injury, particularly in reducing infection risk (Wilson et al., 2026). Adequate protein intake is central to supporting muscle repair and connective tissue adaptation, with intakes of

~1.6–2.1 g·kg⁻¹·day⁻¹ likely appropriate for most cyclists. Micronutrients, such as vitamin C and zinc along with collagen precursors (e.g., glycine and proline) may also contribute to connective tissue health, with some evidence supporting the use of collagen with vitamin C around loading exercises to stimulate tendon repair pathways (Shaw et al., 2017). However, direct evidence that collagen enhances connective tissue protein synthesis in cyclists is lacking and requires further investigation. Concussion and other mild traumatic brain injuries arising from cycling falls can trigger metabolic abnormalities, inflammation, and cellular damage in the brain. Certain nutritional supplements including omega-3 fatty acids (Patch et al., 2021) and creatine (Dolan et al., 2019; Pratt et al., 2026), have the capacity to target these processes and are being studied as potential protective or recovery-aiding supplements. Current clinical human research is, however, insufficient to warrant direct recommendations, and nutritional supplements such as these may best be viewed as promising adjuncts, rather than proven treatment.

Bone Health in Cyclists

Compromised bone health is an important concern for cyclists. A substantial body of evidence indicates that road cyclists in particular tend to have lower bone mass and less robust microarchitecture compared with other athletic groups and nonathletic controls (Saffioti et al., 2026). This is concerning, both in terms of increased fracture risk which can have devastating performance consequences depending on its timing and severity, and a potentially increased risk of osteoporosis development in later life. Several cycling-specific factors may contribute to impaired bone health in cyclists including the low-impact, repetitive loading nature of the sport and increases in bone resorption following long-duration rides. Nutritional factors are also highly relevant particularly LEA and inadequate intake/status of bone-important nutrients, such as calcium, protein, and vitamin D. The relationship between energy availability and bone health is well established and is particularly pertinent in cycling, given the extreme energy demands of some cycling disciplines as well as the strategies involved in achieving or maintaining (what is considered) optimal racing physique (Saffioti et al., 2026). However, this is a complex area to navigate since emerging evidence suggests that CHO availability is important to support bone and that low CHO availability, rather than LEA per se, may drive acute changes in bone biomarkers following short-term energy restriction (Dolan et al., 2024; Fensham et al., 2022), highlighting the importance of considering not only total energy but also nutrient availability (Burke et al., 2023). Therefore, a sound nutrition plan including the periodization of energy and CHO intake, as well as adequate intakes of other bone-relevant nutrients, is important (Table 2). The reader is directed to the companion review (Saffioti et al., 2026) for further details. Furthermore, emerging evidence suggests a role for adequate sleep and psychological stress management in supporting bone and immune health, highlighting the importance of a holistic approach to supporting cyclist health and well-being.

Theme 7: Culinary Support, Travel, and Special Environments

Meeting the nutritional recommendations described throughout this position statement requires translating energy and nutrient targets into palatable, practical, and acceptable meals and foods (Lis & Strobel, 2026). Given the precise and fluctuating nutritional

demands of cyclists, alongside the logistical challenges associated with frequent travel and intensive training and competition schedules, achieving these targets requires careful planning and coordinated input from multiple individuals with clearly delineated and complementary roles. For this reason, most professional cycling teams invest in CNTs, whose primary function is to operationalize evidence-based nutrition strategies through practical food provision.

As described in detail in a companion paper to this position statement (Lis & Strobel, 2026), the CNT typically comprises a performance nutritionist, culinary chefs, and carers (*soigneurs*). The performance nutritionist, usually an accredited sports dietitian or equivalent, leads the development, oversight, and integration of the team's nutrition strategy across training and competition. Trained chefs are responsible for translating this strategy into meals that are safe, practical, and appealing. *Soigneurs* support daily food logistics, feeding operations, and rider well-being. They often act as a key liaison between riders, chefs, and nutritionists, helping to ensure that meals provided align with both the intended nutritional plan and rider preferences.

To effectively fulfill their role, the CNT must work closely with other members of the cycling support team and maintain a detailed understanding of each rider's training and competition schedule, thus allowing nutritional strategies and food provision to align with daily demands. For example, on training days involving prolonged, high-intensity sessions or during competition, CHO intake may be prioritized through emphasizing CHO-rich, easily digestible, relatively low-fiber and low-volume foods, facilitating high CHO availability while minimizing GI discomfort. In contrast, on rest or low-load days, total EI and CHO density may be strategically reduced, while protein intake, micronutrients, and higher fiber foods may be emphasized to support recovery, immune function, and gut health.

Adding to their logistical loads, the CNT must also account for individual preferences, cultural considerations, and specific dietary requirements. These challenges are amplified during travel, due to challenges in sourcing safe or familiar ingredients, variability in kitchen facilities, and disruptions to established food preparation routines. International travel may also expose athletes to extreme environmental conditions such as high altitude, heat, and cold, which introduce additional nutritional considerations, as described below. Strategies to optimize nutritional support in these contexts are discussed in detail in a companion review within this series (Cheung et al., 2026).

Heat

Hot environmental conditions challenge the ability to regulate body temperature and increase the demand for water and electrolytes lost in sweat (Chinevere et al., 2008). The nutritional approach to address this challenge should be tailored to the specific context, noting that performance decrements are observed in hot conditions even with modest fluid deficits (Adams et al., 2019). According to the event and conditions, fluid intake strategies may range from “drinking to thirst” to a more directed “drink schedule” (Cheung et al., 2026). Additional strategies that may mitigate performance losses in the heat include ingestion of an ice slurry before and/or during exercise to take advantage of its higher heat absorption capacity compared with cool water (Siegel et al., 2010; Stanley et al., 2010). For postexercise recovery, the electrolyte content of a beverage/meal plays an important role in the retention of ingested fluids. In particular, the ingestion of sodium chloride via

commercial beverages, dairy drinks, and/or meals with added salt assists in the replacement of sweat electrolyte losses and concomitant restoration of plasma volume and osmolarity (Cheung et al., 2026).

Cold

Cold environmental conditions challenge physiology and performance in several ways even before a decrease in core body temperature and associated performance decrement occurs (Wallace et al., 2024). Cold conditions can involve a range of factors including altered biomechanics and increased clothing that increase the metabolic demands of cycling. This requires consideration to increase EI due to a potential increase in daily EE of ~10% (Cheung et al., 2026). While cold conditions may alter

substrate utilization during exercise, there is no clear rationale or evidence to alter dietary macronutrient composition. Hydration strategies may favor “drink to thirst” approaches since both the magnitude and effects of hypohydration are likely to be less pronounced but should not be completely discounted (Cheung et al., 2026).

Altitude

Altitude exposure in cycling can be a consequence dictated by race course design (*parcours*) or deliberately performed by an athlete in training to gain physiological adaptations to enhance performance in racing. Therefore, there are both acute and chronic effects of altitude exposure to be considered for athletic performance. Acute effects may include increased glycogen utilization, decreased protein synthesis rates, and increased fluid losses via hypoxia and/or low ambient humidity (Brooks et al., 1991; Pasiakos et al., 2017). These factors have potential implications for dietary CHO, protein, and fluid requirements. The general advice is to adjust CHO intake based on training demands and monitor energy availability and fluid balance/hydration status carefully (Cheung et al., 2026).

For athletes using altitude as a physiological stimulus, there are also nutritional considerations to optimize the adaptive response to altitude exposure. One of the main reasons for spending time at altitude is to increase hemoglobin mass and thereby oxygen-carrying capacity of the blood. Iron status is an important factor contributing to changes in hemoglobin mass with altitude exposure (Garvican-Lewis et al., 2018; Govus et al., 2015; Hall et al., 2019), and monitoring of iron status with oral supplementation of 100–200 mg·day⁻¹ elemental iron is recommended (Cheung et al., 2026).

Theme 8: Technological Aids for Meeting Nutrition Goals

Advancements in the use of nutritionally relevant technology in professional cycling can be a double-edged sword. Where technology can provide valid and reliable measures of a variable that can prove useful to an athlete or their support team, technology can make valuable contributions to decision-making processes. If, however, technology is either not valid or reliable or the variable is not useful to inform decision making, it can be a distraction from more useful areas. It is therefore important for practitioners, athletes, and researchers to consider which technologies and variables are valid and reliable to inform nutrition and/or training strategies.

In theory, technology could provide data that are relevant to many areas of nutrition for cycling. These include the potential to measure EE, substrate availability (e.g., continuous glucose monitors [CGMs]) or utilization (e.g., lactate analyzers and portable metabolic analyzers), sweat electrolytes or metabolites, and non-invasive measures of core body temperature, muscle glycogen concentrations, muscle fiber type, and body composition. In practice, however, the value of such data in informing decision making can—at times—be limited. Tools that meet the criteria of sufficient validity and reliability with respect to data that can inform decisions or provide useful insight include power meters (Shute et al., 2019), whereby EE can be predicted with reasonable validity to contribute to information about the energy requirements of an athlete. This can be utilized by coaches for programming and by

THEME 7 KEY POINTS AND SUPPORTING PAPERS WITHIN THE UCI SPORTS NUTRITION PROJECT SERIES

- The cyclists' culinary nutrition team (CNT) is typically comprised of performance nutritionists/dietitians, chefs, and support staff. The CNT plays an important role in integrating the principles of performance nutrition, food preparation, and daily logistics to deliver practical, palatable, and targeted fueling strategies.
- Effective implementation of nutritional strategies requires consideration of fluctuating physiological demands and training objectives, as well as individual preferences and real-world constraints (e.g., daily schedules, food availability, and food preparation resources).
- The CNT must also accommodate special dietary needs, which may involve modification of menus as well as fuel and recovery formulations for athletes with diagnosed food allergies and intolerances.
- Travel imposes additional demands on the rider and the CNT. Logistical issues include food availability and disruptions to usual food preparation routines, while the new environment may involve exposure to environmental stressors (heat, cold, and altitude) that impact training/racing workloads as well as nutritional demands.
- Cycling in hot weather requires a planned approach to fluid intake, with potential use of strategies to induce pre- or between-race cooling (e.g., ingestion of ice slurries).
- Nutritional needs in cold conditions include an increase in energy demands associated with reduced economy/increased energetic cost of cycling, as well as shivering. Meanwhile, fluid losses and the performance decrement associated with dehydration are reduced.
- Nutritional needs at altitude are governed by changes in training characteristics as well as physiological features of altitude (e.g., increased carbohydrate oxidation and higher fluid losses). Iron status is important for hematological adaptations to altitude training blocks and should be supported by regular blood screening to prevent/correct deficiencies, as well as specific supplementation of 100–200 mg·day⁻¹ during altitude training.

Source: Cheung et al. (2026), Lis and Strobel (2026).

nutritional practitioners when determining fueling needs both on and off the bike. As a result, power meters have become nearly ubiquitous across many cycling disciplines.

However, there is insufficient evidence for either a rationale for informing nutritional strategies and/or the quality of data for many other technologies that are promoted among cyclists. Perhaps the most well-documented example of this is CGMs. Despite being originally developed for the management of insulin- and noninsulin-dependent diabetes, CGMs have been repurposed as a possible tool in endurance sports for healthy athletes and marketed as a real-time fuel sensor for detecting substrate (glucose) availability (Bowler et al., 2022). Typically worn on the back of the arm, CGMs measure interstitial glucose concentrations, which can then be relayed wirelessly to a mobile device and/or computer head unit. Unfortunately, these sensors typically exhibit a lag of 10–15 min compared with changes in blood glucose and may not accurately measure blood glucose in environments relevant for cycling, including high-intensity exercise (Skroce et al., 2025) or following food intake (Hutchins et al., 2025). Moreover, sensor placement also impact the data provided, with sensors placed on the leg consistently reporting lower values than those on the arm (Coates et al., 2023). As a result, interpretation and analysis of the data provided is challenging, and it is presently unclear whether these data are relevant or can accurately be used to inform fueling. One promising area of application for CGMs is in the detection of overreaching/overtraining (Coates et al., 2024) and LEA, although more work is required to determine the validity of measuring interstitial glucose in this context (Bowler et al., 2022). It is also important to note that CGMs can only be utilized in training, as wearable sensors capturing metabolic data including (but not

limited to) glucose have been banned by the UCI for use during competition (unless the rider has Type 1 diabetes).

Other major considerations for emerging technologies include accessibility and practicality for use in sport. The application of ultrasound for assessing subcutaneous adipose tissue provides a more accurate alternative to traditional skinfold calipers (Muller et al., 2016); however, the cost of the equipment and requirement for specialized training present a barrier for use by practitioners when tracking body composition of athletes over time. Similarly, proton magnetic resonance spectroscopy has been used to noninvasively assess skeletal muscle fiber type (Baguet et al., 2011). While this has shown promise in athlete talent identification (Lievens et al., 2024), translating this information to inform nutritional practices is difficult given the specialist nature of the equipment.

Theme 9: Supplements and Sports Foods

The use of supplements and sports foods has become ubiquitous among cyclists of all levels and across all disciplines. Indeed, the popularity of sport-specific items is supported by the benefits that may occur through effective delivery of nutrient and energy targets as well as, in a few cases, direct ergogenic effects. However, as illustrated in Table 1, the different disciplines covered by the UCI vary substantially in terms of physiological demands and requirements, ranging from speed/power-based events lasting less than a minute such as BMX and track sprinting to ultraendurance events over several hours such as gravel or road racing. Indeed, even within the same event such as a road stage race, needs differ according to tactics and roles (e.g., sprinter vs. climber vs. general classification rider). As such, making “one-size fits-all” recommendations is neither possible nor advisable.

Supplemental forms of nutrition may assist the cyclist in a number of ways. First, sports foods (sports drinks, gels, protein supplements, and liquid meals, etc.) may provide a practical vehicle to support energy and macronutrient intake during periods of high requirement, including on-bike nutrition plans. Although a “food first” policy is promoted for all cyclists, specially formulated and/or conveniently packaged forms of CHO, protein, and other micronutrients can assist the rider to meet nutrient targets in specialized circumstances or environments. Common types of products in this category can facilitate the achievement of sports nutrition plans but are typically more expensive than everyday foods as well as lacking in the broader range of food-based nutrients and phytochemicals (Whitfield, Egan, et al., 2026). Table 3, supported by reviews of nutritional needs of various cycling disciplines/events (Haakonssen et al., 2026; Jeukendrup et al., 2026; Oosthuysen et al., 2026; Stanley et al., 2026; Whitfield, Mujika, & Burke, 2026), identifies scenarios in which sports foods and drinks can be useful.

Equally, medical supplements used in the prevention and treatment of micronutrient deficiencies (especially Vitamin D, iron, and calcium) provide a concentrated or targeted form of nutrients that are often at risk of outright deficiency as defined by biomarker status or insufficient in the diets of various cycling populations (Whitfield, Egan, et al., 2026). Although these are usually available as “over-the-counter” products, their use is best confined to a therapeutic plan devised and supervised by a sports physician or sports dietitian. Common scenarios of use are covered in Themes 6 and 7 of this position statement and accompanying papers (Burke et al., 2026; Cheung et al., 2026), and a decision tree is provided to

THEME 8 KEY POINTS AND SUPPORTING PAPERS WITHIN THE UCI SPORTS NUTRITION PROJECT SERIES

- Nutritionally relevant technologies, such as power meters, continuous glucose monitors, portable sweat and lactate analyzers, ultrasound, and noninvasive core body temperature sensors have potential applications across multiple cycling domains. Data could theoretically inform or monitor the success of strategies to meet energy demands, achieve fueling strategies, and maximize recovery and adaptation. Data could also assist in tweaking plans to accommodate challenging environments such as heat, cold, and altitude.
- However, the use of these technologies depends on their precision of measurement of the variable of interest, their meaningfulness in health or performance, and the degree to which it can provide actionable insights to inform nutrition and training strategies.
- While some technologies have established utility within a sports nutrition and cycling context (e.g., power meters), many emerging technologies currently lack sufficient evidence of their accuracy (e.g., sweat, lactate and wearable core temperature sensors) or practical application (e.g., ultrasound). Care should be taken to ensure that indiscriminate use does not distract from more robust and evidence-based approaches.

Source: Gonzalez et al. (2026).

assist the rider to make decisions around their personal situation (Figure 1).

Similarly, this process can also be followed for consideration in the use of performance supplements by cyclists (Figure 2). Such products make up the majority of supplements targeted at athletes and, in some cases can be included as ingredients in sports foods/drinks. Most performance supplements, although widely used and promising enthusiastic claims, are not supported by meaningful and event-specific evidence of efficacy/effectiveness (Australian Institute of Sport [AIS], n.d.; Maughan et al., 2018). The UCI Sports Nutrition Project limited its focus to a small group of products that are considered to have a robust evidence base, when used according to specific protocols in specific scenarios (caffeine, creatine, bicarbonate, β -alanine, nitrate/beetroot juice, and glycerol; all included in the Group A of the AIS Sports Supplements Framework), as well as one that has received considerable attention in relation to cycling but with limited support for a defined use (exogenous ketone supplements included in Group B of the AIS Sports Supplements Framework).

THEME 9 KEY POINTS AND SUPPORTING PAPERS WITHIN THE UCI SPORTS NUTRITION PROJECT SERIES

- Sports foods and drinks offer a convenient approach to meeting targeted needs for energy and macronutrients in situations where it is difficult to consume everyday foods. Scenarios where they may be most useful include during intensified training/racing where energy needs are extreme. The benefits of the use of these products and their special formulations should be balanced against their cost and potential to neglect intake of a wider range of micronutrients, food phytochemicals, and fiber.
- Cyclists are often at risk of suboptimal micronutrient status or the requirement for targeted micronutrient support. Here, the use of medical supplements including concentrated amounts of vitamin D, calcium, iron, or other micronutrients, may be useful in preventing or treating deficiencies or providing additional needs for adaptation and health. A decision-tree approach (Figure 1) and supervision of an appropriate sports medicine/nutrition expert can help to optimize the use of these products by riders.
- Of all the performance supplements targeted to riders, only a few are worthy of consideration for evidence-based use (caffeine, creatine, bicarbonate and β -alanine, nitrate/beetroot juice, and glycerol). Again, a decision-tree approach (Figure 2) that considers whether it is appropriate for the individual to consider supplements and the specific pros and cons of the use of each individual product should be implemented.
- Risk management of the potential for antidoping rule violation due to the undeclared or unrecognized content of substances that are prohibited by World Anti-Doping Agency. Even riders at lower levels who are not subjected to doping control activities should reduce their risk of negative outcomes associated with supplements by limiting their use to reputable, evidence-based products that have been specifically subjected to third-party batch testing programs.

Source: Haakonssen et al. (2026), Jeukendrup et al. (2026), Oosthuyse et al. (2026), Stanley et al. (2026), Whitfield, Egan, et al. (2026), Whitfield, Mujika, & Burke (2026).

Table 4 provides a simple summary of the cycling disciplines in which these products might have application, but the specificity of use to the individual rider, the race, and other considerations is noted. Therefore, the reader is directed to the accompanying review of supplements and sports foods in cycling (Whitfield, Egan, et al., 2026), which highlights mechanisms of action, required doses, and suggestions for timing ingestion, as well as the discipline-specific reviews, which provide more detail on application to training and race scenarios (Haakonssen et al., 2026; Jeukendrup et al., 2026; Oosthuyse et al., 2026; Stanley et al., 2026; Whitfield, Mujika, & Burke, 2026). In all scenarios, the evaluation of the incorporation and/or rejection of supplements should be undertaken on a case-by-case basis, balancing the needs of the athlete and the identification of potential performance gaps based on the unique physiological demands of each discipline and the proposed mechanism of action of a supplement (Figure 2).

Some caveats are noted in terms of the evidence base even for the performance supplements that have been considered within the present project. Critically, much of the scientific literature published to date has been performed in lower caliber (i.e., Tiers 2–3) male athletes (Burke et al., 2025; Smith et al., 2022). As such, there is a need for specialized research and/or case studies that capture the nuances of different disciplines with real-world outcomes in both higher tier (i.e., elite and world-class, Tiers 4–5) cyclists and in females. Attention to the measurement of performance with real-world application and capacity to detect effects of meaningful magnitude is also critical (Burke & Peeling, 2018). Furthermore, many of the real-world applications of supplements within cycling disciplines, such as the synergistic/antagonistic effects of the combined use of several products, individual responsiveness to products, and repeated use of products for disciplines with multiple heats/rounds or multiday stages have been neglected (Burke, 2017).

Finally, it is recognized that in most countries, the regulation of supplements is less stringent than that applied to food or pharmaceutical products and mostly occurs as postmarketing checks by agencies that are underresourced for this task (Dwyer et al., 2018; Kozhuharov et al., 2022). In addition to general side effects of use and risk of harm due to the presence of unwanted ingredients, riders who use supplements are at risk of ingesting substances on the World Anti-Doping Agency (WADA) Prohibited List (WADA, 2025) that may be included as unrecognized ingredients or as contaminants. Although a high-performance cyclist may inadvertently consume these agents if they are contained as nondeclared ingredients, the World Anti-Doping Agency Strict Liability rule records an adverse analytical finding against the individual, leading to a ban from their sport and overturning of race results. Risk of inadvertent ingestion of prohibited substances can be mitigated by sourcing all supplements from reputable sources and using samples that have been verified by third-party testing programs (e.g., HFL, HASTA, NSF, and Informed Sport/LGC). Resources such as those produced by Global DRO (<https://www.globaldro.com/Home>), NSF Certified for Sport (<https://www.nsf.org>), the Sports Integrity Australia app (<https://www.sportintegrity.gov.au/resources/sport-integrity-apps-and-vr>), and the Cologne List (<https://www.koelnerliste.com/en/product-database>) provide records of these specific products and batches. Some supplement categories such as “fat burners,” weight gainers, and preworkout products are considered inherently at greater risk of causing harm and an adverse analytical finding (Wardenaar et al., 2025). Finally, the more supplements that an individual uses, the greater the risk of exposure to contamination. Athletes should be informed that all supplement testing programs only reduce the risk of potential contamination with prohibited substances without

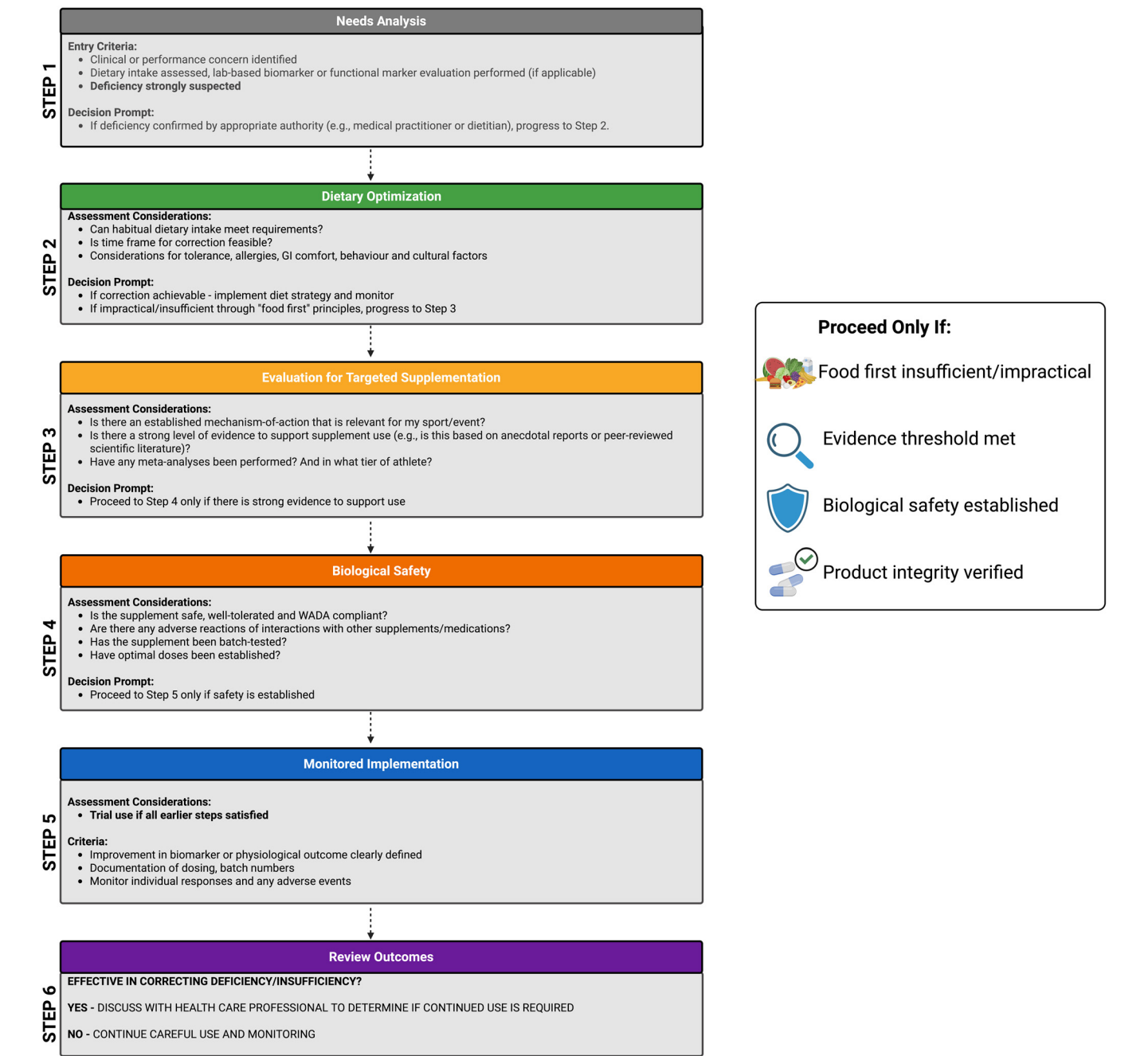


Figure 1 — Making decisions about the use of medical supplements based on treating or preventing nutrient deficiencies in cycling. Created in BioRender. Burke et al. (2026). <https://BioRender.com/vjmw5ht>.

eliminating this risk entirely. As such, supplementation strategies should be limited to an evidence-based approach directly targeting individual cyclists’ needs and objectives.

The latter may involve issues such as differences in resources, and access to expert support, as well as influences from the general community.

Theme 10: Age- and Sex-Related Considerations

Although nutritional considerations for cycling are likely to be primarily driven by the training and competition needs of the event, sex and age may influence nutritional requirements and practices according to both physiological issues and cultural considerations.

Female Cyclists

Many aspects of female reproductive physiology including menarche, the menstrual cycle, hormonal contraceptive use, pregnancy, postpartum, lactation, and menopause have the potential to influence both exercise performance and nutritional requirements. In recent years, there has been growing interest in tailoring nutrition and training programs for female athletes,



Figure 2 — Decision tree for use of performance supplements as part of a cyclist's sports nutrition plan. Created in BioRender. Burke et al. (2026). <https://BioRender.com/>.

Table 4 Framework for the Application of Evidence-Based Supplements Across Cycling Disciplines

	BMX	Track (sprint)	Track (endurance)	Esports	Cyclo-cross/ MTB	Road	Gravel
Beta-alanine	✓	✓	✓	✓	✓	✓	?
Caffeine	✓	✓	✓	✓	✓	✓	✓
Creatine	✓	✓	✓	✓	?	?	?
Dietary inorganic nitrate (e.g., beetroot juice)	✓	✓	✓	✓	?	?	?
Glycerol	X	X	X	X	X	✓	?
Sodium bicarbonate/sodium citrate	✓	✓	✓	✓	✓	?	?
Exogenous ketones	X	X	X	X	X	X	X

Note. Key: ✓, strong evidence to support use; X, not recommended based on current evidence; ?, more discipline-specific evidence required.

with particular emphasis on menstrual cycle phase. Such approaches are based on the premise that fluctuations in reproductive hormones particularly estrogen and progesterone, may influence various aspects of metabolism, recovery, and adaptation (de Jonge, 2003). Consequently, adjusting training and nutritional strategies in accordance with these hormonal fluctuations has been proposed as a means of enhancing training responses and supporting female athletes to optimize performance. Current evidence does not, however, support generalized recommendations for altering training or dietary intake solely based on menstrual cycle phase (Colenso-Semple et al., 2023; D'Souza et al., 2026; McNulty et al., 2020). Instead, individualized approaches are recommended, whereby individual riders track their own cycles and make adjustments based on personal experience and symptoms if the individual rider and their support team deem it necessary.

Emerging evidence indicates that the main menstrual cycle-related factors to impact training and performance may be adverse symptoms, such as cramps, GI distress, or fatigue rather than systemic hormonal fluctuations per se (Bruinvels et al., 2021; Taim et al., 2023). A recent study reported that perceived menstrual cycle-related symptoms, but not systemic hormonal fluctuations, correlated to real-life virtual cycling race performance in a group of female cyclists and triathletes (Smith et al., 2025). In turn, it appears prudent to direct female cyclists toward seeking strategies that may alleviate any symptoms that they are experiencing, rather than focusing on generalized or untargeted training or nutritional adaptations. Several nutritional strategies may help to alleviate specific symptoms, although research in this area is relatively sparse and at times conflicting (Brown et al., 2024). Potentially promising supplements for individuals who experience premenstrual or menstrual-related symptoms include vitamin D, omega-3 fatty acids, magnesium, or zinc. GI distress, such as bloating and diarrhea, are also commonly reported before and during menstruation. In such cases, avoiding foods that may exacerbate these symptoms, such as high-fat, heavily seasoned, or highly processed foods may be beneficial. It is important to emphasize that menstrual experiences are highly individual, as are responses to differing nutritional strategies. Female cyclists are encouraged to monitor their cycle, making notes of factors, such as typical cycle length, ovulation if feasible, and any side effects (be they positive or negative) experienced throughout. Monitoring tools, such as online tracking apps may be useful, although care should be taken with apps that make generic recommendations to adapt either training or dietary practices based solely on menstrual cycle phase. If an individual tends to experience specific symptoms at different phases of their cycle, they can then trial targeted nutritional strategies, in consultation with nutritional professionals. In the case of more severe symptoms, medical support should be sought to rule out any underlying gynecological issues. Furthermore, many female cyclists may use hormonal contraceptives, which lead to distinct hormonal environments, depending on the type and formulation used. Current evidence suggests that hormonal contraceptive use does not adversely impact performance or training responses (Nolan et al., 2024) and, in addition to their contraceptive properties, these may also have some utility in reducing menstrual cycle-related symptoms for affected individuals (Jahanfar et al., 2024).

The relationship between the menstrual cycle and an individual's training is bidirectional. Suboptimal fueling that culminates in chronically LEA can disrupt the cycle, which is considered a key indicator of problematic LEA (Stellingwerff et al., 2023).

Menstrual irregularities, such as a lengthening or cessation of the cycle and particularly those that occur during periods of intensified training or caloric restriction may serve as early indicators of LEA and should prompt a review of dietary intake and training load. Importantly, menstrual dysfunction in multistressor environments may occur due to a range of factors (e.g., underlying gynecological issues or potentially psychological stress; Poitras et al., 2024), highlighting the importance of considering the holistic health and well-being of the athlete.

Junior Cyclists

Regarding younger riders, it is important to consider that adolescence is a key developmental period, and energy or nutrient inadequacies during this period can have long-term health-related consequences if left unchecked. For example, individuals generally reach peak bone mass by approximately 30 years of age, with the majority of bone mass accruing by the age of 20. Failure to optimize peak bone mass can predispose the individual to increased risk of osteoporosis in later life (Eisman et al., 1993). As described in Saffioti et al. (2026), nutritional factors including adequate energy availability may be relevant in protecting cyclist bone health and are particularly relevant for younger riders and during critical periods of bone accrual.

Masters Cyclists

Older athletes or master cyclists may also present some unique nutritional challenges and requirements. Muscle and bone loss are common with aging, which may in part be due to changing activity and nutritional habits across time but also to the natural consequences of aging, which may include increased resistance to the anabolic effects of training (Aragon et al., 2023). Performance, health, and longevity all depend on maintaining muscle mass as long as possible. Nutritional strategies, particularly optimizing protein intake, may help to counteract anabolic resistance and support muscle preservation. Furthermore, and as described in Saffioti et al. (2026), cyclists at all ages tend to have lower than expected bone mass, and the consequences of this may be heightened for older riders, considering the dual challenges that both aging and participation in large amounts of cycle training may pose to the bone. As such, the importance of maintaining adequate energy availability, along with adequacy of bone-important nutrients including protein, CHO, vitamin D, and calcium, may be even higher for older riders. These recommendations may be particularly relevant for female riders, whereby hormonal fluctuations and declines, along with other lifestyle changes throughout the menopausal transition, may pose additional challenges to maintaining bone and muscle mass and function (Lu & Tian, 2023).

Finally, aging may also alter fluid balance regulation, with some evidence suggesting that older adults have a diminished thirst response and sweat capacity (Rolls & Phillips, 1990), which can impair thermoregulation. This has implications for hydration strategies particularly in hot or humid environments, where older cyclists may need more proactive fluid intake plans to support both performance and safety.

Conclusions

Optimal health and performance of cyclists require recognition and implementation of a sound eating plan with consideration of

how nutrition can support training adaptation and recovery, reduce injury and illness, and contribute to competition success. While all riders share these goals, the diverse physiological demands and logistical constraints of different cycling disciplines and events present specific nutritional challenges. The UCI Position Statement on Nutrition for Cycling provides a comprehensive summary of contemporary nutrition knowledge and best practice across a range of cycling disciplines and events. Themes of performance preparation, competition fueling, recovery and adaptation, energy availability, physique management, protection against illness and injury, technological support, the use of supplements and sports foods, and age and sex-specific considerations were identified for commentary. Each rider is encouraged to develop a bespoke approach to their nutrition practices, based on their individual characteristics and goals, as well as the specific demands of their event. The information provided by this position statement and accompanying reviews is promoted as recognition of the UCI's commitment to practices that are contemporary, evidence-based, and supportive of long-term health and performance. However, in recognizing the continual evolution of knowledge and practice, attention is drawn to key areas for future research.

KEY AREAS FOR FUTURE RESEARCH

- What are the key limiting factors in the performance of each cycling discipline/race, and how can these be addressed by nutrition support for training and competition practices?
- What are the sources of interindividual variation between cyclists in terms of nutritional and energy demands during training and racing, and are personalized approaches required?
- How can practical nutrition strategies be developed to support the extreme energy requirements of the training and racing programs undertaken by many riders, especially those who are outside the support of professional teams with sophisticated culinary nutrition teams? How can knowledge and practice be implemented at scale in environments of fewer resources?
- What are the benefits and disadvantages of the currently observed practices of very high carbohydrate intakes ($\geq 120 \text{ g}\cdot\text{h}^{-1}$) in longer races and stage races?
- What is the role of physique and associated characteristics (e.g., power-to-mass ratio) in the short- and long-term performance of each event within cycling disciplines, and how can that be translated into personalized and periodized physique management plans for each rider?
- What characteristics of low energy availability/energy deficit provide the greatest risk for long-term impairment of health and performance (e.g., duration, magnitude, etc.)? What other aspects of nutrient inadequacy (e.g., low carbohydrate availability and inadequate protein intake) contribute to common problems, such as poor bone health and reduced immunity in cyclists?
- If the timing of calcium intake (food and supplement) prior to a cycling session attenuates the acute increase in blood bone turnover biomarkers otherwise seen during exercise, can chronic repetition of this strategy improve bone mineral density in cyclists?
- What nutritional support can be provided to enhance skin health and wound healing (e.g., L-arginine, omega-3 fatty acids, and collagen)?
- What is the role of supplementation with pro- and prebiotics and various antioxidant nutrients in immune support and infection risk/recovery?
- What performance supplements are valuable to support training outcomes and actual competition performance in specific cycling events? How can research protocols investigate real-life performance and real-life issues, such as individual responsiveness, the effects of combining supplements, and the repeated use of supplements in race formats with multiple rounds/stages?

References

- Adams, J., Scott, D., Brand, N., Suh, H., Seal, A., McDermott, B., Ganio, M., & Kavouras, S. (2019). Mild hypohydration impairs cycle ergometry performance in the heat: A blinded study. *Scandinavian Journal of Medicine and Science in Sport and Exercise*, 29(5), 686–695. <https://doi.org/10.1111/sms.13386>
- Aragon, A., Tipton, K., & Schoenfeld, B. (2023). Age-related muscle anabolic resistance: inevitable or preventable? *Nutrition Reviews*, 81(4), 441–454. <https://doi.org/10.1093/nutrit/nuac062>
- Australian Institute of Sport. (n.d.). *Australian Institute of Sport (AIS) sport supplement framework*. <https://www.ausport.gov.au/ais/nutrition/supplemen>
- Baguet, A., Everaert, I., Hespel, P., Petrovic, M., Achten, E., & Derave, W. (2011). A new method for non-invasive estimation of human muscle fiber type composition. *PLoS One*, 6(7), Article e21956. <https://doi.org/10.1371/journal.pone.0021956>
- Bowler, A., Whitfield, J., Marshall, L., Coffey, V., Burke, L., & Cox, G. (2022). The use of continuous glucose monitors in sport: Possible applications and considerations. *International Journal of Sports Nutrition and Exercise Metabolism*, 33(2), 121–132. <https://doi.org/10.1123/ijsnem.2022-0139>
- Brietze, C., Franco-Alvarenga, P., Coelho-Junior, H., Silveira, R., Asano, R., & Pires, F. (2019a). Correction to: Effects of carbohydrate mouth rinse on cycling time trial performance: A systematic review and meta-analysis. *Sports Medicine*, 49(4), 645. <https://doi.org/10.1007/s40279-019-01079-9>
- Brietze, C., Franco-Alvarenga, P., Coelho-Junior, H., Silveira, R., Asano, R., & Pires, F. (2019b). Effects of carbohydrate mouth rinse on cycling time trial performance: A systematic review and meta-analysis. *Sports Medicine*, 49(1), 57–66. <https://doi.org/10.1007/s40279-018-1029-7>
- Brooks, G., Butterfield, G., Wolfe, R., Groves, B., Mazzeo, R., Sutton, J., Wolfel, E., & Reeves, J. (1991). Increased dependence on blood glucose after acclimatization to 4,300 m. *Journal of Applied Physiology*, 70(2), 919–927. <https://doi.org/10.1152/jappl.1991.70.2.919>
- Brown, N., Martin, D., Waldron, M., Bruinvels, G., Farrant, L., & Fairchild, R. (2024). Nutritional practices to manage menstrual cycle related symptoms: A systematic review. *Nutrition Research Reviews*, 37(2), 352–375. <https://doi.org/10.1017/S0954422423000227>
- Bruinvels, G., Goldsmith, E., Blagrove, R., Simpkin, A., Lewis, N., Morton, K., Suppiah, A., Rogers, J., Ackerman, K., Newell, J., & Pedlar, C. (2021). Prevalence and frequency of menstrual cycle symptoms are associated with availability to train and compete: a study of 6812 exercising women recruited using the Strava exercise app. *British Journal of Sports Medicine*, 55(8), 438–443. <https://doi.org/10.1136/bjsports-2020-102792>
- Burke, L. (2017). Practical issues in evidence-based use of performance supplements: Supplement interactions, repeated use and individual

- responses. *Sports Medicine*, 47(S1), 79–100. <https://doi.org/10.1007/s40279-017-0687-1>
- Burke, L., Ackerman, K., Heikura, I., Hackney, A., & Stellingwerff, T. (2023). Mapping the complexities of Relative Energy Deficiency in Sport (REDs): Development of a physiological model by a subgroup of the International Olympic Committee (IOC) Consensus on REDs. *British Journal of Sports Medicine*, 57(17), 1098–1110. <https://doi.org/10.1136/bjsports-2023-107335>
- Burke, L., Gonzalez, J.T., Areta, J., Kuikman, M., Coates, A., Bailey, D., Moran, J., & Dolan, E. (2026). UCI sports nutrition project: Body composition, energy requirements, and energy availability in cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 305–323. <https://doi.org/10.1123/ijnsnem.2025-0255>
- Burke, L., Jeukendrup, A., Jones, A., & Mooses, M. (2019). Contemporary nutrition strategies to optimize performance in distance runners and race walkers. *International Journal of Sports Nutrition and Exercise Metabolism*, 29(2), 117–129. <https://doi.org/10.1123/ijnsnem.2019-0004>
- Burke, L., & Peeling, P. (2018). Methodologies for investigating performance changes with supplement use. *International Journal of Sports Nutrition and Exercise Metabolism*, 28(2), 159–169. <https://doi.org/10.1123/ijnsnem.2017-0325>
- Burke, L., Slater, G., Matthews, J., Langan-Evans, C., & Horswill, C. (2021). ACSM expert consensus statement on weight loss in weight-category sports. *Current Sports Medicine Reports*, 20(4), 199–217. <https://doi.org/10.1249/JSR.0000000000000831>
- Burke, L., van Loon, L., & Hawley, J. (2017). Postexercise muscle glycogen resynthesis in humans. *Journal of Applied Physiology*, 122(5), 1055–1067. <https://doi.org/10.1152/jappphysiol.00860.2016>
- Burke, L., Whitfield, J., & Hawley, J. (2025). The race within a race: Together on the marathon starting line but miles apart in the experience. *Free Radical Biology and Medicine*, 227, 367–378. <https://doi.org/10.1016/j.freeradbiomed.2024.10.277>
- Cheung, S., Stellingwerff, T., Stanley, J., Mujika, I., Nybo, L., & Girard, O. (2026). UCI sports nutrition project: Special environments. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 382–391. <https://doi.org/10.1123/ijnsnem.2025-0101>
- Chinevere, T., Kenefick, R., Cheuvront, S., Lukaski, H., & Sawka, M. (2008). Effect of heat acclimation on sweat minerals. *Medicine & Science in Sports & Exercise*, 40(5), 886–891. <https://doi.org/10.1249/MSS.0b013e3181641c04>
- Coates, A., Cohen, J., & Burr, J. (2023). Investigating sensor location on the effectiveness of continuous glucose monitoring during exercise in a non-diabetic population. *European Journal of Sport Science*, 23(10), 2109–2117. <https://doi.org/10.1080/17461391.2023.2174452>
- Coates, A., Thompson, K., Grigore, M., Baker, R., Pignanelli, C., Robertson, A., Frangos, S., Cheung, C., & Burr, J. (2024). Altered carbohydrate oxidation during exercise in overreached endurance athletes is applicable to training monitoring with continuous glucose monitors. *Scandinavian Journal of Medicine and Science in Sport and Exercise*, 34(1), 14551. <https://doi.org/10.1111/sms.14551>
- Colenso-Semple, L., D'Souza, A., Elliott-Sale, K., & Phillips, S. (2023). Current evidence shows no influence of women's menstrual cycle phase on acute strength performance or adaptations to resistance exercise training. *Frontiers in Sports and Active Living*, 5, 1054542. <https://doi.org/10.3389/fspor.2023.1054542>
- D'Souza, A., Van Every, D., Bhinder, A., Elango, S., Lamont, G., Lees, M., Lim, C., McKendry, J., Newbold, J., Naphin, C., Rebalka, I., Roxburgh, L., Suthaharan, A., Wilson, B., & Phillips, S. (2026). Menstrual cycle phase does not influence training-induced muscle hypertrophy or strength: A randomized controlled trial. *Medicine & Science in Sports & Exercise*. Advance online publication. <https://doi.org/10.1249/MSS.00000000000004031>
- de Jonge, X. (2003). Effects of the menstrual cycle on exercise performance. *Sports Medicine*, 33(11), 833–851. <https://doi.org/10.2165/00007256-200333110-00004>
- de Oliveira, E., Burini, R., & Jeukendrup, A. (2014). Gastrointestinal complaints during exercise: Prevalence, etiology, and nutritional recommendations. *Sports Medicine*, 44(S1), 79–85. <https://doi.org/10.1007/s40279-014-0153-2>
- Derman, W., Badenhorst, M., Eken, M., Gomez-Ereiza, J., Fitzpatrick, J., Gleeson, M., Kunorovza, L., Mjosund, K., Mountjoy, M., Sewry, N., & Schwellnus, M. (2022). Risk factors associated with acute respiratory illnesses in athletes: A systematic review by a subgroup of the IOC consensus on “acute respiratory illness in the athlete.” *British Journal of Sports Medicine*, 56(11), 639–650. <https://doi.org/10.1136/bjsports-2021-104795>
- Ding, S., Jiang, H., & Fang, J. (2018). Regulation of immune function by polyphenols. *Journal of Immunology Research*, 2018, Article 1264074. <https://doi.org/10.1155/2018/1264074>
- Dolan, E., Dumas, A., Esteves, G., Takarabe, L., Perfeito, L., Keane, K., Gualano, B., Kelley, G., Burke, L., Sale, C., & Swinton, P. (2024). The influence of nutrition intervention on the P1NP and CTX-I response to an acute exercise bout: A systematic review with meta-analysis. *Sports Medicine*, 54(11), 2889–2906. <https://doi.org/10.1007/s40279-024-02087-0>
- Dolan, E., Gualano, B., & Rawson, E. (2019). Beyond muscle: the effects of creatine supplementation on brain creatine, cognitive processing, and traumatic brain injury. *European Journal of Sports Science*, 19(1), 1–14. <https://doi.org/10.1080/17461391.2018.1500644>
- Dwyer, J., Coates, P., & Smith, M. (2018). Dietary supplements: Regulatory challenges and research resources. *Nutrients*, 10(1), 41. <https://doi.org/10.3390/nu10010041>
- Ebert, T., Martin, D., Bullock, N., Mujika, I., Quod, M., Farthing, L., Burke, L., & Withers, R. (2007). Influence of hydration status on thermoregulation and cycling hill climbing. *Medicine & Science in Sports & Exercise*, 39(2), 323–329. <https://doi.org/10.1249/01.mss.0000247000.86847.de>
- Eisman, J., Kelly, P., Morrison, N., Pocock, N., Yeoman, R., Birmingham, J., & Sambrook, P. (1993). Peak bone mass and osteoporosis prevention. *Osteoporosis International*, 3, 56–60.
- Fallon, T., Nolan, R., Peters, J., & Heron, N. (2025). “Beyond the finish line” the epidemiology of injury and illness in professional cycling: Insights from a year-long prospective study. *Sports*, 13(1), 20. <https://doi.org/10.3390/sports13010020>
- Fensham, N., Heikura, I., McKay, A., Tee, N., Ackerman, K., & Burke, L. (2022). Short-term carbohydrate restriction impairs bone formation at rest and during prolonged exercise to a greater degree than low energy availability. *Journal of Bone and Mineral Research*, 37(10), 1915–1925. <https://doi.org/10.1002/jbmr.4658>
- Flueck, J. (2021). Nutritional considerations for para-cycling athletes: A narrative review. *Sports*, 9(11), 154. <https://doi.org/10.3390/sports9110154>
- Foo, W., Harrison, J., Mhizha, F., Langan-Evans, C., Morton, J., Pugh, J., & Areta, J. (2022). A short-term low-fiber diet reduces body mass in healthy young men: Implications for weight-sensitive sports. *International Journal of Sports Nutrition and Exercise Metabolism*, 32(4), 256–264. <https://doi.org/10.1123/ijnsnem.2021-0324>
- Fuchs, C., Veeriah, P., Hermans, W., Brauwiers, B., Voncken, R., Brouwers, K., Petrick, H., Hendricks, F., Bels, J., van den Hurk, J., Weber, J., Senden, J., Smith, F., Thelwall, P., Prompers, J., & van Loon, L. (2025). Carbohydrate intake of 10 g/kg body mass rapidly replenishes liver, but not muscle glycogen contents, during 12 h of post-exercise recovery in well-trained cyclists. *Journal of Physiology*. Advance online publication. <https://doi.org/10.1113/JP289115>

- Garvican-Lewis, L., Vuong, V., Govus, A., Peeling, P., Jung, G., Nemeth, E., Hughes, D., Lovell, G., Eichner, D., & Gore, C. (2018). Intravenous iron does not augment the hemoglobin mass response to simulated hypoxia. *Medicine & Science in Sports & Exercise*, 50(8), 1669–1678. <https://doi.org/10.1249/MSS.0000000000001608>
- Gillen, J., West, D., Williamson, E., Fung, H., & Moore, D. (2019). Low-carbohydrate training increases protein requirements of endurance athletes. *Medicine & Science in Sports & Exercise*, 51(11), 2294–2301. <https://doi.org/10.1249/MSS.0000000000002036>
- Gleeson, M. (2016). Immunological aspects of sport nutrition. *Immunology and Cell Biology*, 94(2), 117–123. <https://doi.org/10.1038/icb.2015.109>
- Gonzalez, J., Helleputte, S., van Erp, T., Green, D., Podlogar, T., Derave, W., Jeukendrup, A., & Burke, L. (2026). Nutritionally relevant technological advancements in professional cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 369–381. <https://doi.org/10.1123/ijnsnem.2025-0048>
- Govus, A., Garvican-Lewis, L., Abbiss, C., Peeling, P., & Gore, C. (2015). Pre-altitude serum ferritin levels and daily oral iron supplement dose mediate iron parameter and hemoglobin mass responses to altitude exposure. *PLoS One*, 10(8), e0135120. <https://doi.org/10.1371/journal.pone.0135120>
- Greive, J., Hickner, R., Hansen, P., Racette, S., Chen, M., & Holloszy, J. (1999). Effects of endurance exercise training on muscle glycogen accumulation in humans. *Journal of Applied Physiology*, 87(1), 222–226. <https://doi.org/10.1152/jappl.1999.87.1.222>
- Haakonssen, E., Hogan, K., Stanley, J., O'Bryan, K., & Leckey, J. (2026). UCI sports nutrition project: Competition and training demands, physical characteristics, and nutritional strategies for performance in bicycle motorcross race. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 259–267. <https://doi.org/10.1123/ijnsnem.2025-0087>
- Hall, R., Peeling, P., Nemeth, E., Bergland, D., McCluskey, W., & Stellingwerff, T. (2019). Single versus split dose of iron optimizes hemoglobin mass gains at 2106 m altitude. *Medicine & Science in Sports & Exercise*, 51(4), 751–759. <https://doi.org/10.1249/MSS.0000000000001847>
- Halsen, S. (2019). Sleep monitoring in athletes: Motivation, methods, miscalculations and why it matters. *Sports Medicine*, 49(10), 1487–1497. <https://doi.org/10.1007/s40279-019-01119-4>
- He, C., Yong, X., Walsh, N., & Gleeson, M. (2016). Is there an optimal vitamin D status for immunity in athletes and military personnel? *Exercise Immunology Review*, 22, 42–64.
- Heimer, M., Teschler, M., Schmitz, B., & Mooren, F. (2022). Health benefits of probiotics in sport and exercise - non-existent or a matter of heterogeneity? A systematic review. *Frontiers in Nutrition*, 9, Article 804046. <https://doi.org/10.3389/fnut.2022.804046>
- Hughes, R., & Holscher, H. (2021). Fueling gut microbes: A review of the interaction between diet, exercise, and the gut microbiota in athletes. *Advances in Nutrition*, 12(6), 2190–2215. <https://doi.org/10.1093/advances/nmab077>
- Hutchins, K., Betts, J., Thompson, D., Hengist, A., & Gonzalez, J. (2025). Continuous glucose monitor overestimates glycemia, with the magnitude of bias varying by postprandial test and individual—A randomized crossover trial. *American Journal of Clinical Nutrition*, 121(5), 1025–1034. <https://doi.org/10.1016/j.ajcnut.2025.02.024>
- Impey, S., Hearnis, M., Hammond, K., Bartlett, J., Louis, J., Close, G., & Morton, J. (2018). Fuel for the work required: A theoretical framework for carbohydrate periodization and the glycogen threshold hypothesis. *Sports Medicine*, 48(5), 1031–1048. <https://doi.org/10.1007/s40279-018-0867-7>
- Jahanfar, S., Mortazavi, J., Lapidow, A., Cu, C., Abosy, J., Ciana, H., Morris, K., Steinfeldt, M., Maurer, O., Bohang, J., Anjali Oberoi, R., & Ali, M. (2024). Assessing the impact of hormonal contraceptive use on menstrual health among women of reproductive age - a systematic review. *European Journal of Contraception and Reproductive Health Care*, 29(5), 193–223. <https://doi.org/10.1080/13625187.2024.2373143>
- Jeukendrup, A. (2010). Carbohydrate and exercise performance: the role of multiple transportable carbohydrates. *Current Opinion in Clinical Nutrition and Metabolic Care*, 13(4), 452–457.
- Jeukendrup, A. (2017). Training the gut for athletes. *Sports Medicine*, 47(Suppl. 1), 101–110. <https://doi.org/10.1007/s40279-017-0690-6>
- Jeukendrup, A., Areta, J., Genechten, L., Langan-Evans, C., Pedlar, C., Rodas, G., Sale, C., & Walsh, N. (2024). Does relative energy deficiency in sport (REDs) syndrome exist? *Sports Medicine*, 54(11), 2793–2816. <https://doi.org/10.1007/s40279-024-02108-y>
- Jeukendrup, A., Redegeld, M., Martins, G., Whitfield, J., Mujika, I., Dolan, E., & Gonzalez, J.T. (2026). UCI sports nutrition project: Race nutrition for road cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 215–232. <https://doi.org/10.1123/ijnsnem.2025-0239>
- Jeukendrup, A., Wagenmakers, A., Stegen, J., Gijzen, A., Brouns, F., & Saris, W. (1999). Carbohydrate ingestion can completely suppress endogenous glucose production during exercise. *The American Journal of Physiology*, 276(4), E672–E683.
- Karelis, A., Smith, J., Passe, D., & Peronnet, F. (2010). Carbohydrate administration and exercise performance: What are the potential mechanisms involved? *Sports Medicine*, 40(9), 747–763. <https://doi.org/10.2165/11533080-000000000-00000>
- Kozhuharov, V., Ivanov, K., & Ivanova, S. (2022). Dietary supplements as source of unintentional doping. *BioMed Research International*, 2022(1), 8387271. <https://doi.org/10.1155/2022/8387271>
- Langan-Evans, C., Hearnis, M., Gallagher, C., Long, S., Thomas, C., Moss, A., Cheung, W., Howatson, G., & Morton, J. (2023). Nutritional modulation of sleep latency, duration, and efficiency: A randomized, repeated-measures, double-blind deception study. *Medicine & Science in Sports & Exercise*, 55(2), 289–300. <https://doi.org/10.1249/MSS.0000000000003040>
- Lievens, E., Van de Casteele, F., De Block, F., Van Vossel, K., Vandenbogaerde, T., Sandford, G., Bellinger, P., Minahan, C., Bourgois, J., Stellingwerff, T., Mujika, I., & Derave, W. (2024). Estimating muscle fiber-type composition in elite athletes: A survey on current practices and perceived merit. *International Journal of Sports Physiology and Performance*, 19(11), 1197–1208. <https://doi.org/10.1123/ijsp.2024-0043>
- Lis, D.M., & Strobel, N. (2026). UCI sports nutrition project: Plate to performance—Culinary nutrition support for professional road cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 335–351. <https://doi.org/10.1123/ijnsnem.2025-0198>
- Loucks, A.B., Kiens, B., & Wright, H.H. (2011). Energy availability in athletes. *Journal of Sports Sciences*, 29(Suppl. 1), 37–41.
- Lu, L., & Tian, L. (2023). Postmenopausal osteoporosis coexisting with sarcopenia: The role and mechanisms of estrogen. *Journal of Endocrinology*, 259(1), e230116. <https://doi.org/10.1530/JOE-23-0116>
- Mancin, L., Burke, L., & Rollo, I. (2025). Fibre: The forgotten carbohydrate in sports nutrition recommendations. *Sports Medicine*, 55(5), 1067–1083. <https://doi.org/10.1007/s40279-024-02167-1>
- Maughan, R.J., Burke, L.M., Dvorak, J., Larson-Meyer, D.E., Peeling, P., Phillips, S.M., Rawson, E.S., Walsh, N.P., Garthe, I., Geyer, H., Meeusen, R., Van Loon, L.J.C., Shirreffs, S.M., Spriet, L.L., Stuart, M., Vernec, A., Currell, K., Ali, V.M., Budgett, R.G., ... Engebretsen, L. (2018). IOC consensus statement: Dietary supplements and the high-performance athlete. *British Journal of Sports Medicine*, 52(7), 439–455. <https://doi.org/10.1136/bjsports-2018-099027>
- McNulty, K., Elliott-Sale, K., Dolan, E., Swinton, P., Ansdell, P., Goodall, S., Thomas, K., & Hicks, K. (2020). The effects of menstrual cycle

- phase on exercise performance in eumenorrheic women: A systematic review and meta-analysis. *Sports Medicine*, 50(10), 1813–1827. <https://doi.org/10.1007/s40279-020-01319-3>
- Morton, J., Fell, J., Gonzalez, J., Hearnis, M., Podlogar, T., Pugh, J., & Wallis, G. (2026). From metabolism to medals: Contemporary perspectives and revisiting carbohydrate guidelines for fueling endurance athletes during exercise. *Journal of Nutrition*, 156(5), 101442. <https://doi.org/10.1016/j.tjnut.2026.101442>
- Morton, J., Hearnis, M., Fell, M., Owens, D., Halson, S., & Trommelen, J. (2026). UCI sports nutrition project: Nutritional periodization: Strategies to enhance training adaptation and recovery. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 279–304. <https://doi.org/10.1123/ijnsnem.2025-0073>
- Mountjoy, M., Ackerman, K., Bailey, D., Burke, L., Constantini, N., Hackney, A., Heikura, I., Melin, A., Pensgaard, A., Stellingwerff, T., Sundgot-Borgen, J., Torstveit, M., Jacobson, A., Verhagen, E., Budgett, R., Engebretsen, L., & Erdener, U. (2023). 2023 International Olympic Committee's (IOC) consensus statement on relative energy deficiency in sport (REDs). *British Journal of Sports Medicine*, 57(17), 1073–1098. <https://doi.org/10.1136/bjsports-2023-106994>
- Mujika, I., Ronnestad, B., & Martin, D. (2016). Effects of increased muscle strength and muscle mass on endurance-cycling performance. *International Journal of Sports Physiology and Performance*, 11(3), 283–289. <https://doi.org/10.1123/ijsspp.2015-0405>
- Muller, W., Lohman, T., Stewart, A., Maughan, R., Meyer, N., Sardinha, L., Kiriheenedige, N., Reguant-Closa, A., Risoul-Salas, V., Sundgot-Borgen, J., Ahammer, H., Anderhuber, F., Furhapter-Rieger, A., Kainz, P., Materna, W., Pils, U., Pirstinger, W., & Ackland, T. (2016). Subcutaneous fat patterning in athletes: selection of appropriate sites and standardisation of a novel ultrasound measurement technique: ad hoc working group on body composition, health and performance, under the auspices of the IOC Medical Commission. *British Journal of Sports Medicine*, 50(1), 45–54.
- Nishimura, Y., Langan-Evans, C., Taylor, H., Foo, W., Morton, J., Shepherd, S., Strauss, J., Burniston, J., & Areta, J. (2025). Endocrine, metabolic, and skeletal muscle proteomic responses during energy deficit with concomitant aerobic exercise in humans. *The FASEB Journal*, 39(21), e71163. <https://doi.org/10.1096/fj.202502384RR>
- Nolan, D., McNulty, K., Manninen, M., & Egan, B. (2024). The effect of hormonal contraceptive use on skeletal muscle hypertrophy, power and strength adaptation to resistance exercise training: A systematic review and multilevel meta-analysis. *Sports Medicine*, 54(1), 105–125. <https://doi.org/10.1007/s40279-023-01911-3>
- Oosthuysen, T., Muros, J.J., & Zabala, M. (2026). UCI sports nutrition project: Nutrition for mountain biking and cyclocross. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 245–258. <https://doi.org/10.1123/ijnsnem.2025-0036>
- Padilla, S., Mujika, I., Cuesta, G., & Goiriena, J. (1999). Level ground and uphill cycling ability in professional road cycling. *Medicine & Science in Sports & Exercise*, 31(6), 878–885. <https://doi.org/10.1097/00005768-199906000-00017>
- Pasiakos, S., Berryman, C., Carrigan, C., Young, A., & Carbone, J. (2017). Muscle protein turnover and the molecular regulation of muscle mass during hypoxia. *Medicine & Science in Sports & Exercise*, 49(7), 1340–1350. <https://doi.org/10.1249/MSS.0000000000001228>
- Patch, C., Hill-Yardin, E., Lewis, M., Ryan, L., Daly, E., & Pearce, A. (2021). The more, the better: High-dose omega-3 fatty acids improve behavioural and molecular outcomes in preclinical models in mild brain injury. *Current Neurology and Neuroscience Reports*, 21(9), 45. <https://doi.org/10.1007/s11910-021-01132-z>
- Peters, H., van Schelven, F., Verstappen, P., de Boer, R., Bol, E., Erich, W., can der Togt, C., & de Vries, W. (1993). Gastrointestinal problems as a function of carbohydrate supplements and mode of exercise. *Medicine & Science in Sports & Exercise*, 25(11), 1211–1224.
- Philp, A., Hargreaves, M., & Baar, K. (2012). More than a store: Regulatory roles for glycogen in skeletal muscle adaptation to exercise. *American Journal of Physiology. Endocrinology and Metabolism*, 302(11), E1343–E1351. <https://doi.org/10.1152/ajpendo.00004.2012>
- Pinckaers, P., Kouw, I., Gorissen, S., Houben, L., Senden, J., Wodzig, W., de Groot, L., Verdijk, L., Snijders, T., & van Loon, L. (2023). The muscle protein synthetic response to the ingestion of a plant-derived protein blend does not differ from an equivalent amount of milk protein in healthy young males. *Journal of Nutrition*, 152(12), 2734–2743. <https://doi.org/10.1093/jn/nxac222>
- Pinckaers, P., Trommelen, J., Snijders, T., & van Loon, L. (2021). The anabolic response to plant-based protein ingestion. *Sports Medicine*, 51(S1), 59–74. <https://doi.org/10.1007/s40279-021-01540-8>
- Poitras, M., Shearadz, F., Qureshi, A., Blackburn, C., & Plamondon, H. (2024). Bloody stressed! A systematic review of the associations between adulthood psychological stress and menstrual cycle irregularity. *Neuroscience and Biobehavioural Reviews*, 163, 105784. <https://doi.org/10.1016/j.neubiorev.2024.105784>
- Pratt, J., Fuchs, C., van Loon, L., Kennerley, A., & Sale, C. (2026). Creatine supplementation and brain health: Methodological challenges, current evidence, and translational perspectives. *The Journal of Nutritional Physiology*, 5(1), 100017. <https://doi.org/10.1016/j.jnphys.2026.100017>
- Rollo, I., Gonzalez, J., Fuchs, C., van Loon, L., & Williams, C. (2020). Primary, secondary, and tertiary effects of carbohydrate ingestion during exercise. *Sports Medicine*, 50(11), 1863–1871. <https://doi.org/10.1007/s40279-020-01343-3>
- Rolls, B., & Phillips, P. (1990). Aging and disturbances of thirst and fluid balance. *Nutrition Reviews*, 48(3), 137–144. <https://doi.org/10.1111/j.1753-4887.1990.tb02915.x>
- Rooney, D., Sarriegui, I., & Heron, N. (2020). “As easy as riding a bike”: A systematic review of injuries and illness in road cycling. *BMJ Open Sport and Exercise Medicine*, 6(1), e000840. <https://doi.org/10.1136/bmjsem-2020-000840>
- Rothschild, J., Dudley-Rode, H., Carpenter, H., Smith, A., Plews, D., & Maund, E. (2026). Carbohydrate ingestion during prolonged exercise and net skeletal muscle glycogen utilization: A meta-analysis. *Journal of Applied Physiology*, 140(1), 76–87. <https://doi.org/10.1152/jappphysiol.00861.2025>
- Saffioti, N., Takarabe, L., Perfeito, L., Ribeiro, W., Hilken, L., Van Dyk, J., & Dolan, E. (2026). UCI sports nutrition project: Does cycling create a “perfect storm” for bone health? Cycling-specific challenges to bone and nutritional strategies to overcome these. *International Journal of Sport Nutrition and Exercise Metabolism*, 36(3), 324–334. <https://doi.org/10.1123/ijnsnem.2025-0033>
- Sanchez-Munoz, C., Mateo-March, M., Muros, J., Javaloyes, A., & Zabala, M. (2023). Anthropometric characteristics according to the role performed by World Tour road cyclists for their team. *European Journal of Sport Science*, 23(9), 1821–1828.
- Shaw, G., Lee-Barthel, A., Ross, M., Wang, B., & Baar, K. (2017). Vitamin C-enriched gelatin supplementation before intermittent activity augments collagen synthesis. *American Journal of Clinical Nutrition*, 105(1), 136–143. <https://doi.org/10.3945/ajcn.116.138594>
- Shute, R., Zak, R., & Slivka, D. (2019). Validity and reproducibility of commercial cycling power meters in hot and cold environmental temperatures. *Journal of Science and Cycling*, 8(1), 32–39. <https://doi.org/10.28985/jsc.v8i1.504>
- Siegel, R., Mate, J., Brearley, M., Watson, G., Nosaka, K., & Laursen, P. (2010). Ice slurry ingestion increases core temperature capacity and running time in the heat. *Medicine & Science in Sports & Exercise*, 42(4), 717–725. <https://doi.org/10.1249/MSS.0b013e3181bf257a>

- Skroce, K., Turner, L., Fontana, F., Bettega, S., Nardelli, S., Jeukendrup, A., Zisser, H., Schena, F., Tarperi, C., & Riddell, M. (2025). Assessing the accuracy of a continuous glucose monitoring system across varying exercise intensities and blood lactate concentrations in healthy male athletes. *Journal of Diabetes, Science and Technology*, 19(1), 274–276. <https://doi.org/10.1177/19322968241292363>
- Smith, E., McCormick, R., McKay, A., Ackerman, K., Elliott-Sale, K., Stellingwerff, T., Harris, R., & Burke, L. (2025). Perceived negative menstrual cycle symptoms, but not changes in estrogen or progesterone, are associated with impaired cycling race performance. *Medicine & Science in Sports & Exercise*, 57(3), 590–599. <https://doi.org/10.1249/MSS.0000000000003587>
- Smith, E., McKay, A., Kuikman, M., Ackerman, K., Harris, R., Elliott-Sale, K., Stellingwerff, T., & Burke, L. (2022). Auditing the representation of female versus male athletes in sports science and sports medicine research: Evidence-based performance supplements. *Nutrients*, 14(5), 953. <https://doi.org/10.3390/nu14050953>
- Somerville, V., Braakhuis, A., & Hopkins, W. (2016). Effect of flavonoids on upper respiratory tract infections and immune function: A systematic review and meta-analysis. *Advances in Nutrition*, 7(3), 488–497. <https://doi.org/10.3945/an.115.010538>
- Stanley, J., Leo, P., Haakonssen, E., & Leckey, J. (2026). UCI sports nutrition project: Performance nutrition for sprint and endurance track cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 233–244. <https://doi.org/10.1123/ijnsnem.2025-0043>
- Stanley, J., Leveritt, M., & Peake, J. (2010). Thermoregulatory responses to ice-slush beverage ingestion and exercise in the heat. *European Journal of Applied Physiology*, 110(6), 1163–1173. <https://doi.org/10.1007/s00421-010-1607-3>
- Stellingwerff, T., Morton, J., & Burke, L. (2019). A framework for periodized nutrition for athletes. *International Journal of Sports Nutrition and Exercise Metabolism*, 29(2), 141–151. <https://doi.org/10.1123/ijnsnem.2018-0305>
- Stellingwerff, T., Mountjoy, M., McCluskey, W., Ackerman, K., Verhaagen, E., & Heikura, I. (2023). Review of the scientific rationale, development and validation of the International Olympic Committee Relative Energy Deficiency in Sport Clinical Assessment Tool: V.2 (IOC REDs CAT2)-by a subgroup of the IOC consensus on REDs. *British Journal of Sports Medicine*, 57(17), 1109–1121. <https://doi.org/10.1136/bjsports-2023-106914>
- Taim, B.C., Ó Catháin, C., Renard, M., Elliott-Sale, K.J., Madigan, S., & Ní Chéilleachair, N. (2023). The prevalence of menstrual cycle disorders and menstrual cycle-related symptoms in female athletes: A systematic literature review. *Sports Medicine*, 53(10), 1963–1984. <https://doi.org/10.1007/s40279-023-01871-8>
- ter Steege, R., Geelkerken, R., Huisman, A., & Kolkman, J. (2012). Abdominal symptoms during physical exercise and the role of gastrointestinal ischaemia: A study in 12 symptomatic athletes. *British Journal of Sports Medicine*, 46(13), 931–935. <https://doi.org/10.1136/bjsports-2011-090277>
- ter Steege, R., & Kolkman, J. (2012). Review article: the pathophysiology and management of gastrointestinal symptoms during physical exercise, and the role of splanchnic blood flow. *Alimentary Pharmacology and Therapeutics*, 35(5), 516–528. <https://doi.org/10.1111/j.1365-2036.2011.04980.x>
- Thomas, D., Erdman, K., & Burke, L. (2016). American College of Sports Medicine Joint Position Statement. Nutrition and athletic performance. *Medicine & Science in Sports & Exercise*, 48(3), 543–568. <https://doi.org/10.1249/MSS.0000000000000852>
- Thurber, C., Dugas, L., Ocobock, C., Carlson, B., Speakman, J., & Pontzer, H. (2019). Extreme events reveal an alimentary limit on sustained maximal human energy expenditure. *Science Advances*, 5(6), Article eaaw0341. <https://doi.org/10.1126/sciadv.aaw0341>
- Valenzuela, P., Leo, P., Mateo-March, M., Gallo, G., Seiler, S., & Mujika, I. (2026). UCI Sports Nutrition Project: The science of successful cycling performance. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 174–186. <https://doi.org/10.1123/ijnsnem.2025-0157>
- Wallace, P., Hartley, G., Nowlan, J., Ljubanovich, J., Sieh, N., Taber, M., Gagnon, D., & Cheung, S. (2024). Endurance capacity impairment in cold air ranging from skin cooling to mild hypothermia. *Journal of Applied Physiology*, 136(1), 58–69. <https://doi.org/10.1152/japplphysiol.00663.2023>
- Wardenaar, F., Burns, S., Campos, M., Chan, Y., Claassen-Smithers, A., Dunshea-Mooij, C., Eddine Haddou, S., Hoogervorst, D., Jagim, A., Reinaldo Garcia, P., Garthe, I., Nugent, A., Ossama Aly, M., Saunders, B., Schott, K., Sekiguchi, Y., Slater, G., Speers, N., Stratton, M., & Aussieker, T. (2025). Navigating the risks beyond the label: Unpacking global nutritional supplement safety. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(2), 134–166. <https://doi.org/10.1123/ijnsnem.2025-0177>
- Whitfield, J., Egan, B., Del Coso, J., Derave, W., Saunders, B., & Burke, L. (2026). UCI sports nutrition project: Considerations and applications for the use of sports foods and supplements to improve performance in cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 187–214. <https://doi.org/10.1123/ijnsnem.2025-0111>
- Whitfield, J., Mujika, I., & Burke, L. (2026). UCI sports nutrition project: Nutrition for the emerging cycling disciplines of esports and gravel. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 268–278. <https://doi.org/10.1123/ijnsnem.2025-0189>
- Wilson, K., St-Onge, M., & Tasali, E. (2022). Diet composition and objectively assessed sleep quality: A narrative review. *Journal of the Academy of Nutrition and Dietetics*, 122(6), 1182–1195. <https://doi.org/10.1016/j.jand.2022.01.007>
- Wilson, P.B., Pyne, D.B., & Rotunno, A. (2026). UCI sports nutrition project: The role of nutrition in the prevention and management of illnesses and injuries in elite cycling. *International Journal of Sports Nutrition and Exercise Metabolism*, 36(3), 352–368. <https://doi.org/10.1123/ijnsnem.2025-0144>
- Witard, O., Hearnis, M., & Morgan, P. (2025). Protein nutrition for endurance athletes: A metabolic focus on promoting recovery and training adaptation. *Sports Medicine*, 55(6), 1361–1376. <https://doi.org/10.1007/s40279-025-02203-8>
- World Anti-Doping Agency. (2025). *World anti-doping code international standard prohibited list*. https://www.wada-ama.org/sites/default/files/2024-09/2025list_en_final_clean_12_september_2024.pdf
- Yao, J., Wen, J., Yang, Z., Lin, Y., Sun, L., Lu, Q., & Fan, G. (2022). Flavonoid-containing supplements for preventing acute respiratory tract infections: A systematic review and meta-analysis of 20 randomized controlled trials. *Complementary Therapies in Medicine*, 70, 102865. <https://doi.org/10.1016/j.ctim.2022.102865>
- Zhao, Y., Dong, B., & Hao, Q. (2022). Probiotics for preventing acute upper respiratory tract infections. *The Cochrane Database of Systematic Reviews*, 24(8), 8.
- Zuraikat, F., Wood, R., Barragan, R., & St-Onge, M. (2021). Sleep and diet: Mounting evidence of a cyclical relationship. *Annual Review of Nutrition*, 41(1), 309–332. <https://doi.org/10.1146/annurev-nutr-120420-021719>