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10 QUESTIONS; 10 EXPERTS

Summary of the 2024 Professionals in Nutrition for Exercise and Sport "10 Questions/10 Experts" Session—Hot Topics for the Paris Olympic Games

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This article provides a recap of the *10 Questions/10 Experts* session at the 2024 American College of Sports Medicine Annual Meeting. Each of the speakers considered the validity of common "myths," while providing evidence-based opinions to support, or, bust, myths addressing the following questions: (1) Would 100 g/hr of carbohydrate be advisable for the Olympic Cycling Road race? (2) Is there an advantage in the marathon of ingesting bicarbonate as a hydrogel product? (3) Can genotyping be used to individualize caffeine supplementation in football? (4) Should low fluid consumers drink more to improve 1,500-m track performance? (5) Do urinary markers of dehydration predict poor basketball performance? (6) Do placebo effects influence 10-km track performance? (7) Should combat athletes make weight using glucagon-like peptide-1 receptor agonists? (8) Would crushed ice ingestion help tennis umpires make better decisions in the heat? (9) Are collagen supplements useful to reduce tendon and ligament injuries in volleyball? and (10) Should female athletes plan their training and diet according to their menstrual cycle? This article describes the content of each of the presentations including the most important outcomes and conclusions drawn by the presenters.

Keywords: carbohydrate, fluid, ergogenic aids, GLP-1 agonist, sports nutrition

A highlight of the American College of Sports Medicine Annual Meeting is the lively *10 Questions/10 Experts* session hosted by Professionals in Nutrition for Exercise and Sport (PINES; https://pinesnutrition.org). Organized by Professor Louise Burke and Professor Emerita Melinda Manore, the 2024 session offered a dynamic approach to sports nutrition myths related to the (at the time of the conference) upcoming Summer Olympics.

The principle of the session, originally designed by Professor Ron Maughan, was to offer a "speed dating" approach to topical issues in sports nutrition. Showcasing 10 myths, assigned to a sports nutrition researcher or practitioner, invited to tackle the proposition within 3 min, before declaring it to be "confirmed," "busted," or "equivocal."

This article recaps the sessions' insights, presented by a blend of emerging and experienced science communicators. Each of the speakers reflected on novel ideas from current sports nutrition practices used in elite sports, resulting in valuable updates for those working in the field of sports and nutrition.

10 Sport-Based Questions Answered by 10 Experts

Would 100 g/hr of Carbohydrate Be Advisable for Olympic Road Cycling?

Trent Stellingwerff, PhD, answered this question by addressing the following proposition: "The gold medalist will gain a performance advantage by jumping onto the 'carbolution' of >100 g/hr of carbs during the Olympic road race." There is a long history showing a positive impact of carbohydrate (CHO) supplementation on endurance exercise performance, with one of the first publications stemming from the 1925 Boston marathon (Gordon et al., 1925). When athletes consume the current consensus recommended 30–90 g/hr of CHO during endurance exercise (Burke et al., 2011), they perform better than athletes who fail to

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take any CHO intake (Stellingwerff & Cox, 2014). More recently, glucose–fructose blends have been shown to be superior to glucose alone for both enhancing exogenous CHO oxidation, as well as performance (Jeukendrup, 2010). Given muscle might be able to take up 120–140 g of carbohydrates per hour if glucose can be maximally transported and absorbed through the gut and liver (Hawley et al., 1994), the question arises: Would >100 g carb/hr be even more beneficial? However, in some athletes, these potential benefits come with a higher risk of creating gastrointestinal (GI) distress, which is thought to be attenuated and mitigated via gut training.

Hence, endurance athletes should routinely practice their fueling strategies during training sessions to figure out their individual fueling and hydration sweet spot. Although more research is needed to confirm this, several initial studies have demonstrated that the type of CHO (liquid, solid, sports drink, energy bar) used for fuel appears to not matter as long as the athlete is drinking enough fluid (Hearris et al., 2022; Pfeiffer et al., 2010).

Was the Myth busted?

- It depends, the myth can be CONFIRMED, BUSTED, or considered EQUIVOCAL. CONFIRMED: "if" the other competitors in the race are only consuming water; EQUIVOCAL: "if" the other competitors in the race are not maximizing their CHO intakes (more research needed on performance outcomes of moderate to high CHO intakes vs. ultra-high CHO intakes on performance is required); BUSTED: if the "mega" amounts of ingested CHO caused significant GI distress during the race.
- Explanation: This "carbolution" is potentially based on the following factors: (a) the further implementation of multitransportable glucose–fructose blends, which allows for optimal CHO oxidation and enhanced performance outcomes compared with isocaloric glucose blends (Jeukendrup, 2010); (b) new hydrogel technologies that may increase gastric emptying, increasing CHO delivery, and minimizing gastrointestinal intolerances (King et al., 2022); (c) implementing prerace GI training (Chicharro, 2011); and (d) enhancing day in and day out recovery from training and multiday racing through extra CHO caloric intake (Achten et al., 2004); Whether this myth is busted or not always depends on the context of the race situation, resulting in various outcomes.
- Additional reading: Stellingwerff and Cox (2014).

Is There an Advantage in the Marathon of Ingesting Bicarbonate as a Hydrogel Product?

Jason Siegler, PhD, answered this question by addressing the following proposition: "The Maurten™ Bicarb System is way better than standard bicarb loading products/protocols. Its enhanced buffering capacity will propel the gold medalist to the finish line." For decades, sodium bicarbonate (bicarb) supplementation has been used by elite sprint-endurance athletes as a strategy to buffer the performance-eroding rise in hydrogen ions in their muscles (Carr et al., 2011). One of the largest hurdles to overcome, however, has been the potential for GI distress that often accompanies this supplement when ingested in pill or liquid form. A new technology has emerged that may eliminate this issue, making this supplement a more viable candidate for other events. As such, the question has been asked as to whether or not bicarb delivered via this new technology can improve marathon performance—perhaps during breakaways or in a sprint to the finish? While we have no data in general on bicarb for marathon performance, we do know that endurance exercise at intensities commensurate with elite marathon performance is often associated with GI distress, which beyond bicarb supplementation, can limit the efficacy of any nutritional support (e.g., fluids or CHO). However, if the new Maurten Bicarb System acts similarly to the company's line of Gels by bypassing the stomach and minimizing gas, bloating, or other GI distress, then further investigation is warranted. Anecdotal support has also recently come in the form of elite athlete feedback (including marathoners), who say they can perform better with the Bicarb System.

Was the Myth busted?

- At this stage, there is too little empirical data on the Maurten Bicarb System to either confirm or refute the myth.
- Explanation: Sodium bicarbonate (bicarb) has been used by elite athletes for decades, predominately during training or competitions requiring intense, prolonged bouts of either single or repeated efforts in an attempt to mitigate excessive hydrogen ion production in the working muscles. The question currently being asked, however, is whether or not this new hydrogel delivery system can be used to improve marathon performance, specifically to augment performance during breakaways or in a sprint to the finish. While we have no empirical data on the efficacy of using any form of bicarb to improve marathon performance, we do know that historically, ingesting bicarb in pill, or liquid form, and in the doses shown to improve performance can create gas, bloating, and severe GI distress. Recently, Maurten has introduced bicarb into their patented hydrogel delivery system (Bicarb System), which theoretically allows the bicarb to bypass the acidity of the stomach and be absorbed in the intestine, thus avoiding large shifts in partial pressure of carbon dioxide which occur when bicarb is ingested in pill or liquid form. Indeed, Gough and Sparks have observed significant elevations in blood bicarbonate (~6–8 mmol/L, which is similar to traditional loading doses) while nearly eliminating GI discomfort after using the Bicarb System (Gough & Sparks, 2024). Anecdotally, we are aware of multiple instances of elite athletes acknowledging the benefits of this proprietary delivery system, including those competing in events such as the marathon. Although these early reports are encouraging, more studies are needed to demonstrate conclusively whether or not the reduced GI discomfort using the Bicarb System manifests into training and/or performance improvement. Therefore, we cannot objectively conclude at this point whether or not a marathon runner would confer an advantage using the Maurten Bicarb System.
- Additional reading: Gough and Sparks (2024) and Siegler et al. (2016).

Can Genotyping Be Used to Individualize Caffeine Supplementation in Football?

Bryan Saunders, PhD, answered this question by addressing the following proposition: "Every player should get 'caffeine genotyped' to have an individualized caffeine use protocol." Caffeine is a popular preexercise supplement used to enhance exercise performance, with some athletes appearing to be more sensitive to caffeine's effects than others. Athletes can take caffeine in the form of pills (starting somewhere between 3 and 6 mg of caffeine/kg body weight; 200–400 mg for a 68-kg/150-lb athlete) or

drink coffee (about 150–200 mg/12-ounce cup) an hour before exercise—though coffee's caffeine content is highly variable (McCusker et al., 2003), meaning supplements may be preferable to ensure the desired dose is achieved. For a quicker caffeine fix, caffeinated gum (developed by the military) gets caffeine into the system within 15 min and also has performance-enhancing effects (Barreto et al., 2023). Although doses in excess of 6 mg/kg have been shown to be effective, these are generally associated with greater incidence and intensity of side effects which may actually harm performance. Thus, an upper limit of 6 mg/kg might be favorable. There is some suggestion that not all individuals achieve performance-enhancing benefits from caffeine supplementation (Pickering & Grgic, 2019; Southward et al., 2018), though many studies fail to truly evaluate individual response as this can only be achieved via multiple exposures. Nonetheless, potential variability in the response to caffeine has been suggested to be caused via factors, such as baseline performance, habitual caffeine consumption, and genetics.

The CYP1A2gene encodes the cytochrome p450 1A2 enzyme that is responsible for metabolizing ~95% of all ingested caffeine. A single nucleotide polymorphism in this gene impacts the activity of the enzyme, meaning approximately 45% of athletes metabolize caffeine quickly (AA homozygotes), 45% moderately (AC heterozygotes), and 10% slowly (CC homozygotes) (Sachse et al., 1999), but there is some controversy as to how this influences the performance-enhancing effect of caffeine between athletes. A meta-analysis suggests that fast and moderate metabolizers benefit from caffeine, while slow metabolizers actually performed worse with caffeine (Barreto et al., 2024). Nonetheless, these data are hugely skewed by baseline performance, perceived conflicts of interest and poor study designs which, when removed from the analysis, suggest no influence of genotype CYP1A2 on caffeine's performance-enhancing effects. There is no strong evidence to suggest other genotypes, such as ADORA2A, influence caffeine's performance enhancing effects (Dos Santos et al., 2023; Glaister et al., 2021).

Was the Myth busted?

- Yes, the myth is BUSTED.
- Explanation: There is no strong evidence to suggest caffeine's rate of metabolism dictates its ergogenic effect, though more independent research is needed to determine how effective caffeine is for slow metabolizers who may benefit less (Barreto et al., 2024). There is no other good evidence to suggest other genotypes, such as ADORA2A, influence caffeine's performance enhancing effects (Glaister et al., 2021). Current scientific evidence does not support a substantial influence of genetics on caffeine's performance-enhancing effect. Given caffeine's performance benefits appear unrelated to a specific gene, athletes need not spend money on getting "caffeine genotyped"!
- Additional reading: Barreto et al. (2024) and Glaister et al. (2021).

Should Low Fluid Consumers Drink More to Improve 1,500-m Track Performance?

Floris Wardenaar, PhD, answered this question by addressing the following proposition: "Runners who are naturally low fluid consumers will improve their race performance in the heat of Paris by drinking more fluid daily." Dehydration can impair exercise performance in the heat, for example, by increasing heart rate which has a negative impact on endurance exercise performance (Adams et al., 2014). Acute fluid loss can be easily measured (pre–post body weight change) and serve as a reliable proxy marker for sweat loss (Maughan et al., 2007). Aside from the acute fluid loss during exercise, a low daily fluid intake can result in concentrated urine, without experiencing significant body weight loss, or an altered thirst response (Kavouras, 2019). Although there are only limited data, optimizing daily hydration could have a positive impact on short-duration exercise performance.

Was the Myth busted?

- No, the myth is EQUIVOCAL, although plausible, given more research is needed. Explanation: For athletes who routinely fail to consume enough fluid throughout the day, making the daily effort to drink more fluids resulting a low urine concentration could potentially improve their performance. This is specifically the case for short duration exercise, like middle-distance running events (lasting 3–15 min). Likely, this performance enhancing impact of fluid optimization will be most effective during short performances, when dehydration levels are not negatively impacting performance, such may be the case during longer duration exercise performance. Young athletes improving their hydration performed significantly better on a 600 m after receiving hydration education (Kavouras et al., 2012). Young college age men and women who had been identified as low drinkers based on having a high urine concentration also improved 2-mile run performance when they increased their fluid intake (Kooima et al., 2024). Overall, more research investigating the impact of precompetition hydration optimization is needed. Current research suggests that monitoring urine color and quantity can give a reasonable indication of urine concentration to better understand the athlete's hydration status (Wardenaar, 2022).
- Additional reading: Kavouras et al. (2012) and Kavouras (2019).

Do Urinary Markers of Dehydration Predict Poor Basketball Performance?

Patrick Wilson, PhD, answered this question by addressing the following proposition: "Over half of players start games hypohydrated and their performance will suffer unless they test their urine to assess hydration." Several studies suggest that 52%–80% of basketball players begin games in a hypohydrated state, defined as having a urine specific gravity (USG) higher than 1.020 (Heishman et al., 2021; Osterberg et al., 2009; Vukašinović-Vesić et al., 2015). However, it can be questioned if the cutoff value to detect underhydration (>1.020) should be based on a one-size-fits-all approach, as factors such as body composition and race/ethnicity have been associated with urine concentration; therefore, having a USG of >1.020 doesn't always mean an athlete is hypohydrated.

Was the Myth busted?

- No, the myth is EQUIVOCAL. The myth was partially busted, because despite athletes reporting urine concentrations above the regularly suggested cutoff, this may not always indicate underhydration. Explanation: Despite the literature reporting 52%–80% of basketball athletes having a USG of 1.020 or higher (Heishman et al., 2021; Osterberg et al., 2009; Vukašinović-Vesić et al., 2015), the rate of preexercise hypohydration negatively impacting performance is probably less than what has been reported in the literature. One reason

for this is that large, muscular athletes produce more creatinine due to greater body stores of creatine (Hamouti et al., 2010; Wilson, 2021). Thus, they typically have higher baseline USG. In addition, Black or African American individuals tend to have higher USG levels than White individuals independent of fluid intake (Winter et al., 2024). It is indeed plausible that some athletes would improve their performance if they were better hydrated.

- Additional reading: Wilson (2021) and Winter et al. (2024).

Do Placebo Effects Influence 10-km Track Performance?

Eimear Dolan, PhD, answered this question by addressing the following proposition: "Every runner should have a supplement that they believe in. It doesn't matter if it doesn't actually work: the placebo effect is a race winner in its own right." Coming from Latin the word *placebo* means "I shall please." A placebo offers a pleasing effect and can enhance performance in its own right—irrespective of whether the treatment itself has active properties. For example, if you take a supplement that you believe in (it pleases you), it is possible that you will be able to perform better—even if research suggests the supplement doesn't actually work. Evidence from both a clinical and sporting context indicates that an individual's expectation of the supplement/treatment influences the extent of placebo effect (Gurton et al., 2023; Rosenkjær et al., 2022). In other words, the stronger your belief, the larger the effect.

Sports nutritionists should only recommend supplements that have a solid evidence base supporting their safety and physiological efficacy. It is, however, important to be aware that supplementation has both a physiological and a psychological component. This means that the way a supplement is described and offered can influence its overall effect. The supplement industry commonly exploits the placebo effect. Some companies make a lot of money from a supplement proven to *not* work. Professionals that work in sport and exercise nutrition should seek ways to harness, but never to exploit, the placebo effect.

Was the Myth busted?

- No, the myth has been CONFIRMED.
- Explanation: If the core question here is *does the placebo effect influence sports performance,* this myth is confirmed. The placebo/nocebo effect, namely whether positive/negative expectation about an intervention can influence response to that intervention, is supported by results from numerous studies, which have been synthesized in systematic reviews and meta-analyses (Hurst et al., 2019; Marticorena et al., 2021). The notion of placebo has also been widely studied in the health and medical fields, and is accepted as an important factor in clinical practice (Evers et al., 2018). In fact, estimates indicate that the placebo effect could account for a considerable portion of the overall performance benefits of commonly used sports supplements, with a meta-analysis by Marticorena et al. (2021) estimating that it could contribute to approximately 25%–60% of the overall efficacy of caffeine and buffering supplements. This finding has important practical implications in that it highlights that sport supplement use comprises both a physiological and a psychological component. Sports nutritionists should keep this in mind when working with athletes. Certainly, only evidence-based supplements should be recommended; however, it is important to consider that the belief that an athlete holds about that supplement can increase—or reduce—its effect on performance. Adequate communication and athlete buy-in may be crucial to improving the likelihood of each individual experiencing a positive effect.
- Additional reading: Hurst et al. (2020), Marticorena et al. (2021) and Evers et al. (2018).

Should Combat Athletes Make Weight Using GLP-1 Receptor Agonists?

John Hawley, PhD, answered this question by addressing the following proposition: "Ozempic for the win over making weight!" Ozempic is an injectable prescription drug approved by the U.S. Food and Drug Administration and recommended for people with overweight/obesity and type 2 diabetes for weight loss, improved blood glucose control, and reduced feelings of appetite and hunger. Ozempic works by triggering insulin release from the pancreas and blocking glucagon secretion. Given that athletes are interested in many potentially ergogenic substances, legal and not-so-legal, the day might come when weight-conscious athletes look to Ozempic (or similar drugs) for help with rapid weight loss. They have dabbled with everything else; why not this?

Was the Myth busted?

- No, the myth is EQUIVOCAL. Although plausible, more research is needed. Explanation: These weight loss prescription medications have yet to be studied by sports nutrition researchers in athletic populations and raise questions, such as *How much of any weight loss will be lost as skeletal muscle?* and *might this drug have a deleterious effect on bone?* The rapid and marked weight loss induced by GLP-1-based anti-obesity medications may result in physical frailty or sarcopenia, although the evidence is equivocal. Nonetheless, there is considerable heterogeneity in the contribution of fat-free mass and skeletal muscle mass to the total decrease in body weight among studies, and between participants within studies, highlighting the urgent need for research to determine the effect of Ozempic (and other weight-loss medications) on muscle loss and functional outcomes in athletic populations (Conte et al., 2024).
- Additional reading: Conte et al. (2024).

Would Crushed Ice Ingestion Help Tennis Umpires Make Better Decisions in the Heat?

Cas Fuchs, PhD, answered this question by addressing the following proposition: "The umpire should consume slushies while sitting in the heat of center court to stay cool and reduce their bad calls due to the impairing effects of hyperthermia." The Summer 2024 Olympics in Paris, held in July and August, experienced hot and humid conditions, with temperatures exceeding 30 °C. While these temperatures were high, they were not as extreme as in July 2019, when Paris recorded its highest temperature ever, at 42.6 °C with around 20% humidity. In such extreme conditions, not just athletes but also, spectators, venue workers, and umpires—who must maintain high cognitive function while sitting passively in the heat—should be careful to avoid overheating. This brings us to the question: should umpires consume slushies to stay cool and reduce bad calls due to hyperthermia?

Cognitive brain function declines when body temperature rises above 39 °C. Therefore, it is important to apply strategies to avoid such body temperature increases. However, when sitting passively

in the heat, staying well hydrated, dressing in comfortable clothing, and sitting in the shade are likely sufficient to keep the body cool enough to maintain good brain function.

Was the Myth busted?

- Yes, the myth was BUSTED.
- Explanation: Research has shown that being passively exposed for 4 hr in temperatures of 43 °C with 33% humidity increases core body temperature to around 38.5 °C (Dumke et al., 2015). Interestingly, an increase in core body temperature to about 38.5 °C may actually improve cognitive function, whereas cognitive function has been shown to decline when body temperature rises above this threshold (Schmit et al., 2017). Therefore, since core body temperature is unlikely to exceed this critical threshold of 38.5 °C even under these extreme conditions, the umpires' cognitive abilities are unlikely to become impaired. Thus, consuming slushies is generally not necessary for umpires. However, implementing proper strategies to stay cool is still important to avoid further increases in core body temperature. Under hot conditions, everyone involved in the Olympics or any other tournaments in the future should stay well hydrated, dress in comfortable clothing, and sit in the shade. These strategies, used under passive conditions, will likely keep the body cool enough to maintain good brain function. Therefore, the myth that "The umpire should consume slushies while sitting in the heat of center court to stay cool and reduce their bad calls due to the impairing effects of hyperthermia" is busted.
- Additional reading: Schmit et al. (2017).

Are Collagen Supplements Useful to Reduce Tendon and Ligament Injuries in Volleyball?

Thorben Aussieker, MSc, answered this question by addressing the following proposition: "The best players in the world have ACL strains and tendon problems. Collagen supplements are the Spike for tendon and ligament support." Up to 40%–50% of professional volleyball athletes report to have patellar tendinopathy, also called jumper's knee (Lian et al., 2003, 2005). Interestingly, symptomatic patellar tendinopathy is associated with morphological changes of the patellar tendon in volleyball players (Kulig et al., 2013). It could be assumed that these athletes have impaired protein turnover in their patellar tendon. Collagen supplementation has been suggested to improve connective tissue remodeling as it provides substantial amounts of the amino acids glycine and proline, which are the more prevalent amino acids in bodily collagen (Alcock et al., 2019; Holwerda & Van Loon, 2022). Therefore, collagen supplements are touted to strengthen tendons and ligaments, with the end goal of connective tissues becoming less likely to get injured.

Was the Myth busted?

- Yes, the myth was BUSTED.
- Explanation: Collagen protein or gelatin ingestion strongly increase circulating plasma glycine and proline concentrations (Alcock et al., 2019; Aussieker et al., 2023). It has been reported that serum samples obtained after gelatin ingestion in vivo in humans stimulate in vitro collagen synthesis when applied on engineered ligaments (Shaw et al., 2017). Furthermore, long-term collagen supplementation has been reported to increase the cross-sectional area of tendons (Jerger et al., 2022). However, similar results on tendon cross-sectional area have been shown with the supplementation of dairy protein (Farup et al., 2014). We performed a study to compare the impact of collagen and dairy protein ingestion on muscle connective protein synthesis rates (Aussieker et al., 2023). Our data suggest that protein ingestion can increase muscle connective protein synthesis rates. However, no differences were observed between collagen and whey protein ingestion on muscle connective protein synthesis rates during recovery from exercise. Therefore, based on current data, the myth that collagen protein should be used by volleyball players for tendon support is busted. This is due to the fact that any beneficial effect of collagen protein is most likely a protein effect, which is not limited to collagen protein alone. However, more research is needed to investigate effects of collagen protein ingestion on turnover rates of collagen rich tissues, such as tendons, ligaments, cartilage and bone.
- Further reading: Holwerda and Van Loon (2022).

Should Female Athletes Plan Their Training and Diet According to Their Menstrual Cycle?

Stuart Phillips, PhD, answered this question by addressing the following proposition: "The US Soccer Team will win the gold medal because of their game changing 'cycle synching' practices of eating and training according to their menstrual phase." Empowering a woman to track her cycle and look for how it impacts her, as an individual, is a big step forward for the sports world; only recently has menstruation even been discussed by coaches and trainers. Although recent research studies have found no definitive effect of the menstrual cycle on female athletes' ability to perform (Taim et al., 2023), adaptations to resistance training (Colenso-Semple et al., 2023), and for example substrate oxidation (D'Souza et al., 2023), some women talk about symptoms (ranging from mild to very severe) that can lead to suboptimal performance. Cycle Synching—tailoring food and exercise to menstrual cycle phase—is currently practiced by some athletes and teams, but such practice is without any good supportive evidence. There are no hard-fixed physiological reasons to cycle sync. We do not want to set athletes up to believe they will perform worse at certain times of the cycle. But belief has a strong effect. If a team believes cycle syncing offers benefits, it may do, but the same would be true of any strong suggestive programming of athletes' expectations.

Was the Myth busted?

- Yes, the myth was BUSTED, but to some extent the myth can also be considered EQUIVOCAL. Explanation: In well-controlled studies, there is no effect of menstrual cycle phase on metabolism or performance (Taim et al., 2023), so there is no need to prioritize training or nutrition; however, symptoms may impact performance and should be taken into account.
- Further reading: Taim et al. (2023), Colenso-Semple et al. (2023), and D'Souza et al. (2023).

Conclusions

The answers of each of the 10 presenters need to be seen in the context of the propositions they were asked to investigate. The thought provoking and opinion-based answers aim to initiate discussion among sports nutrition practitioners and scientists, and are by no means providing a complete picture.

The quick takeaways would be as follows, starting with CHO:

- For carbohydrates the advice would always depend on the context of the race situation, and the context of how much other competitors are fueling and hydrating, as to whether consuming 100 g CHO/hr would be the most beneficial CHO advice.

The session also addressed the importance of fluid intake in three different ways:

- Low fluid consumers could potentially improve short performance bouts by optimizing their hydration level.
- Additionally, low fluid intakes may result in impaired performance, but to determine hydration levels using urine concentration practitioners may need to consider the influence that factors, such as body composition, and race, or ethnicity may have on selecting the right cutoff value to determine a low versus high urine concentration.
- While the core body temperatures of umpires (e.g., during a tennis match) are unlikely to exceed critical levels that impair cognition, consuming slushies is not necessary, but referees should still ensure they stay well-hydrated, dress comfortably, and sit in the shade during extreme heat to maintain optimal cognitive function.

When considering nutritional supplements, such as the use of sodium bicarbonate, caffeine, or collagen, placebo effect may also have a substantial role. The four different takeaways were:

- The placebo effect is likely to influence sports performance, and at least some portion of the effects reported for some supplements considered to be performance enhancing are the result of the placebo effect.
- Solutions that help sodium bicarbonate bypass the stomach could potentially help to reduce user discomfort.
- There is no strong evidence to suggest that different genotypes substantially modify caffeine's performance-enhancing effects, and therefore, genotyping related to caffeine use is unlikely to be relevant for athletes.
- Currently, there is no definitive evidence that collagen supplements are more effective than other protein supplements in promoting tendon and ligament synthesis.

The last two takeaways regarding the use of GLP-1 receptor agonist and the menstrual cycle conclude:

- No published data are available to support the effectivity of GLP-1 receptor agonist in athletes, and research is needed to determine the impact of the resulted weight loss on skeletal muscle mass, strength, and function.
- Currently, there is no evidence that the menstrual cycle is related to exercise metabolism or performance, but addressing individual symptoms may help to optimize performance.

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Professionals in Nutrition for Exercise and Sport (PINES) is a leading global organization of qualified nutrition and exercise professionals who strive for excellence in sports nutrition to achieve optimal support for performance, health, and injury prevention for active and athletic individuals worldwide. The authors of this article are PINES members and exemplify PINES' mission to grow and nurture a global community of PINES members. PINES aims to do so by connecting and encouraging members to develop and share evidence-based knowledge, practices, and experiences, and to provide education, guidance, and thought leadership in sport and exercise nutrition. More information about PINES can be found at: https://pinesnutrition.org. **Disclosures:** Clark, Stellingwerff, Siegler, Wilson, Fuchs, Aussieker, Manore, Hawley, and Burke report no conflict of interest. The other authors report no conflict of interest related to the work presented in this article, but disclose the following interests: Wardenaar received grants from external partners that were not related to this project from: Arizona Parks & Trails, Pac-12 Health and Wellbeing Initiative, the Collegiate and Professional Sports Dietetic Organization, Standard Process Inc., Kraft Heinz Company, Unilever Corporation, FrieslandCampina, FEMA, and the Arizona Board of Regents. Saunders has previously received caffeine supplements at no cost from a national supplement company (Farmácia Analítica, Rio de Janeiro, Brazil) for work unrelated to the current article. Farmácia Analítica has not had any input (financial, intellectual, or otherwise) into the contents of the work presented in this article. Dolan is financially supported by a grant from the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP 2019/05616-6) for a project unrelated to this one. Fuchs and Aussieker represented the M3 research group led by L.J.C. van Loon that has received research grants, consulting fees, speaking honoraria, or a combination of these for research on the impact of exercise and nutrition on muscle metabolism, which include research funding from companies such as PepsiCo, APRE, GELITA AG, and PB Leiner. A full overview on research funding is provided at https://www.maastrichtuniversity.nl/l.vanloon. Phillips has received grant funding from the Canadian Institutes for Health Research, the National Science and Engineering Research Council of Canada, the U.S. National Institutes for Health, Roquette Freres, Nestle Health Sciences, Friesland Campina, The U.S. National Dairy Council, and Dairy Farmers of Canada and Myos. Phillips has received travel expenses and honoraria for speaking from Nestle Health Sciences, Optimum Nutrition, and Nutricia. Phillips holds patents licensed to Exerkine Inc. but reports no financial gains.

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