Recovery Antagonized Training at the 2014 Meeting of the American College of Sports Medicine

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Nutrition Report with Louise Burke: GSSI symposium; PINES special event. **Nutrition Reflections** with Jeni Pearce. **Performance Highlights** with Dave Martin. **Noteworthy Abstracts** with Will Hopkins. Acute Effects: warm-ups. Correlates of Performance: genes. Nutrition and Drugs: acute supplementation with nitrate, dark chocolate, glucose+fructose, tyrosine, protein, L-alanine; mouth rinse with carbohydrate, quinine; ammonia inhalants; caffeine; recovery with an EAS product, cherry juice, chocolate milk; training with Rhodiola crenulata, naproxen. Training: resistance with cold-water immersion; interval; tapering; accommodation resistance; neuromuscular for injury risk; "sportomic" tracking; heart-rate variability for individual responses. KEYWORDS: anabolic, elite athletes, ergogenic aids, nutrition, performance, tests, training.

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The annual meeting of the American College of Sports Medicine (this year in Orlando, Florida, May 27-31) was again a joint conference not only for Exercise is Medicine but also for a world congress on the role of inflammation in exercise, health and disease. Sport performance–the focus of this report–was therefore represented by only a minor proportion of the ~3500 presentations, but there were enough fascinating findings to make up for the shortfall in quantity.

This report is a joint effort by Louise Burke, Jeni Pearce, Dave Martin and Will Hopkins. Louise, Jeni and Dave attended the meeting and have provided first-hand accounts of keynote and other featured presentations, none of which have abstracts. As usual, Will did not attend the meeting but has summarized the abstracts of the slide and poster sessions, where all the new research was presented.

The ACSM conference site provides various links to information about the meeting, and you can access the conference abstracts via this link. Use the advanced search form (Ctrl-Shift-F) in Adobe Acrobat to find abstracts featured in this report via the number in brackets […]. (Numbers with a letter in front indicate sessions: A for Wednesday morning through G for Saturday morning.) You will get several hits, but you can quickly home in on the right one. The abstracts are also freely available in the May supplement of Medicine and Science in Sports and Exercise, but searching for individual abstracts via the abstract number with the advanced search form (enter 46 in the Volume field and 5s in the Issue field) is inefficient.

Nutrition Report

with Louise Burke

Over the past couple of years, the day preceding the official start of the ACSM annual meeting has become a ritual for those interested in sports nutrition: a symposium sponsored by the Gatorade Sports Science Institute and a special event organized by PINES (Professionals in Nutrition for Exercise and Sport). The talks in the symposium may soon be available at the GSSI website, while the PINES event will be reported in full at the PINES site and in *International Journal of Sport Nutrition and Exercise Metabolism*. Meantime, here are my summaries and a summary of special presentations on nutrition at the ACSM meeting itself.

GSSI Symposium

The Future of Sports Nutrition commenced with a presentation from Asker Jeukendrup, who took us back through the history of sports nutrition (diets of ancient Olympians, early Tour de France eating quirks) before predicting

that the future would involve greater emphasis on **nutrition solutions for individual athletes**. My contribution on **supplements** straddled three topics: **benefits** (providing practical ways to meet nutrient intake goals, preventing/treating nutrient deficiencies, in a few cases achieving a direct performance enhancement, and delivering a valuable placebo effect); **risks** (distracting athletes from tackling more important performance factors; emphasizing the overhyped products or chaotic patterns of use in favor of evidence-based products used appropriately, toxicity and side-effects, inadvertent anti-doping rule violations); and **regulation** (national regulation of food and drugs, anti-doping codes, rules within sports systems, public opinion). Matthew Pahnke discussed common causes of gut ischemia and disturbance during exercise (type and intensity of exercise, exercise nutrition, genetics) as well as remedial actions (**gut tolerance training** for fluid and carbohydrate intake, potential use of products such as **glutamine and nitrate supplements** to enhance gut perfusion). Luc van Loon updated guidelines for protein intake to promote exercise adaptation, including recommendations for **protein** type (high content of leucine), amount (20-25 g serves) and timing (post-exercise, spread every 3-5 hours over the day, pre-bed). Daniel Medina completed the session by describing the systems, resources and protocols needed to implement a **nutrition program** spanning food service, education, counselling and supplement use within a professional football team (Barcelona FC).

PINES Special Event

We continued the tradition of having 10 experts respond to 10 questions with three slides in three minutes, followed by interaction with the audience. The 2014 theme addressed the search by athletes for **the next superfood or phytochemical** that can improve performance, recovery, body composition or resilience (to illness or injury).

1. Is **watermelon** (a source of citrulline) another stimulant of nitric oxide, and would a watermelon/beetroot cocktail be the ultimate red “go fast” juice? Andy Jones: potentially interesting but watermelon doesn’t contain enough citrulline.

2. Do exotic **cherries and berries** offer benefits to sports performance? Phillip Bell: perhaps, but optimal use to reduce muscle soreness is not clear.

3. How much **creatine, carnitine and carnosine** did our cave-dwelling ancestors consume in their daily diets? Must modern athletes turn to supplements to achieve optimal levels of these components? Roger Harris: hard to be definitive, but probably, and yes.

4. What’s the latest on **food polyphenols** and how should athletes consume them? David Nieman: still no evidence to support single use of foods or supplement polyphenols; cocktails may solve bioavailability.

5. Does **curcumin** offer any benefits to chronic inflammation or bone health in athletes at high risk, and how should it be consumed? Ashley Smuder: interesting but too early to be sure.

6. Can **green-tea** extract help athletes to manage their body composition? Rebecca Randall: evidence for an extra 1 kg loss of body fat in treatment for obesity but unlikely to be worthwhile for athletes.

7. Are athletes interested in **synthetic antioxidants** targeting mitochondria and do they offer performance benefits? Scott Powers: no evidence that such antioxidants are useful for sports performance.

8. Are there differences between **caffeine** from gum, coffee and other sources when it comes to athletic performance? Lawrence Spriet: modest caffeine intakes from all sources may offer performance benefits in various sports. [WGH: if you have to say "may" about the effect of caffeine, there's no point in doing any research on athletic performance.]

9. Do any **vegetable protein** sources match the value of whey for muscle protein synthesis, and how can they be manipulated to increase their value for muscle adaptation? Luc van Loon: most vegetable proteins are lower in leucine content than whey but could be fortified with this important amino acid.

10. How easy is it to take a new superfood from research evidence to **commercial production**? Eric Zaltas: the pathway is lengthy, but you meet some interesting characters along the way.

ACSM Meeting

My personal highlight was a symposium on the **two-hour marathon,** which followed up a popular point-counterpoint in Journal of Applied Physiology in 2011. Sandra Hunter dissected several strategies to determine the equiv-

alent to the two-hour barrier in **female marathon runners**. In some experts' opinions, the current world record of 2:15:25 by Paula Radcliffe has already surpassed this mark, implying that the best woman is relatively better than the best man. Mike Joyner reviewed the characteristics of **world-best marathon runners** (small physique, lifelong training, altitude natives) and extrapolated the theoretical equivalent of the current world 10-km record (26:20) to a 2.01-2.02 h marathon. Andy Jones discussed the limitations in sustainable metabolic rate and running economy to running at 21.1 km/h for 2 hours. He noted that **running economy** could be improved by strategies such as drafting, increasing reliance on carbohydrate as muscle substrate, and using nitrate supplementation. He outlined the physiological formula for the runner who could theoretically achieve the feat by sustaining a fractional utilization of 80% of a VO2max of 80 ml/kg/min with a running economy of 180 ml/min/km) in the right race conditions (strategic drafting, a flat course and a cool day). Alejandro Lucia finished by discussing various genetic traits that might assist marathon running, noting that Asia might be the home of the runner most suited to a world-best marathon time.

A symposium on the effects of mild **hypohydration** on exercise revealed assessment tools to monitor small deficits in body water (Lawrence Armstrong), interaction of dehydration and environment on body temperature and performance (Doug Casa), evidence of possible changes in metabolism during exercise, such as glycogen utilisation (Lawrence Spriet), and evidence for performance changes (Stavros Kavouras). The 2014 review of hypohydration and exercise by Cheuvront and Kenefick in *Comprehensive Physiology* provided a frequently cited resource for this session.

A colloquium discussed the outcome of strategies to reduce the health risks associated with **weight-making practices** in collegiate wrestling. Strategies introduced following the deaths of three wrestlers in 1991 included a change in weight categories, the movement of the weigh-in time until 2 h prior to wrestling, the establishment of a minimum wresting weight equivalent to 5% body fat, and a maximum rate of weight loss allowed over the season. Important features of the changes included enforcing rules in practice and an emphasis on competition performance rather than ability to make weight. Although there has been a reduction in the amount of weight lost acutely before weigh-in and regained afterward, there is still evidence of abuse and only a minority of athletes has a weight-making plan. Updated information on weight-making practices in combat sports can be found in the report from a survey of athletes who competed at the 2012 Olympic Games (Gibson, *International Journal of Wrestling Science* 2013).

Ron Maughan and I conducted a tutorial on the outcomes of the FINA consensus meeting on Nutrition for **Aquatic Sports**, held in London in December 2013. We reviewed the findings of a group of expert practitioners, scientists and administrators from the sports of pool swimming, open-water swimming, diving, water polo and synchronized swimming. Separate summaries were made of the challenges and strategies of optimal nutrition for each of these aquatic disciplines, along with the common issues of **physique and body image** concerns, use of dietary **supplements**, managing **illness and injury,** and coping with **travel and special environments**. Outputs from this meeting include a series of reviews in *International Journal of Sport Nutrition and Exercise Metabolism* and education resources for athletes and coaches, available (eventually) via this link at the FINA site.

Anne Loucks provided a tutorial update on the **treatment of low energy availability** in female athletes. She noted differences between energy availability and energy balance. Energy availability (energy intake minus the energy cost of exercise) is under voluntary control, unlike energy balance, where resting metabolic rate accounts for ~2/3 of energy expenditure and can be suppressed. Errors in measurement of fat free mass, exercise energy expenditure and energy intake contribute to the substantial error in energy availability, but it remains a useful concept for dealing with the "healthiness" of dietary patterns of athletes, particularly in weight-conscious sports. I contributed to this session by summarizing the **strategies** used to assess and modify low energy availability with a wholistic approach to the quality and quantity of food choices, the achievement of specific nutritional support around training sessions, and a restoration of the inclusion of social interaction and enjoyment around eating.

Finally, I concluded a busy conference program by conducting a tutorial on implementing strategies to **train with low glycogen** ("train low") in a periodized training and nutrition program. I noted that this concept is frequently misunderstood or oversimplified and that current studies of train-low strategies have failed to see performance benefits probably because they fail to sufficiently simulate the complex interaction of "train high" and "train low" sessions in the ideal periodised training program. Examples of such programs were provided from a range of different sports.

Nutrition Reflections

with Jeni Pearce

The Tuesday preconference, organized by Gatorade and PINES, were a great way for everyone interested in sport nutrition to start the conference (over 300 people attended each). These two sessions will be back in 2015.

There is much work to be done in the area of a healthy **microbiome** (gut bacteria). Have a century of antibiotic use and abuse finally come back to haunt us? The metabolism and biochemistry sessions addressing this issue were interesting but did contain sufficient evidence for changes in current best practice.

Authors of only one of the many posters on supplements had checked the composition of the supplement and had it tested for **banned substances**. (The Informed Sport logo was on the poster.). Many of these studies showed the expected benefits of caffeine, and several reported no benefits from a range of herbal products (also to be expected). Of concern was a study showing that the banned substance DHEA worked–not the message I felt should be promoted. The presenter wasn't there when I went to ask how they got the study approved.

A great session from the US Olympic Committee covered the impact of the **medical, dental and nutrition services** over the last two Olympic Games (London and Sochi). The dental session was particularly brutal, with photography of all the injuries highlighting the importance of mouth guards, especially the high quality three-piece bonded variety. Nanna Meyer (USOC sports dietitian from Colorado) gave a great overview of the sport nutrition strategies and management of the USOC winter speed skating team she has worked with for 15 years. Young practitioners benefited from this session by seeing the influence of a sports dietitian at the team and individual level, the commitment and creativity required, and the application of research and experience. Nanna reviewed the challenges at international events and the focus on making sure basic requirement are met. Janice Thompson's presidential lecture reminded those of us in the field of nutrition of the wider global and cultural impact of our work.

My take home message… Louise's session on **carbohydrate availability** should be compulsory for all practitioners prescribing the train-low (carbohydrate) strategy. It is crucial for practitioners to understand low energy availability and to be on the alert for it, as there are adverse effects on performance and especially training if the more familiar markers are absent (low BMI, body fat and bone density).

Performance Highlights

with Dave Martin

Thirty-one posters were presented under the heading *Characterizing the* **Competitive Athlete** [230-260], including collegiate football, swimming, soccer, lacrosse, ice hockey, wrestling track and field, race walking, team handball, table tennis, and even NASCAR Sprint Cup pit crew. As new technologies make it easier to monitor heart rate, respiratory rate and skin temperature during training and competition, there is an increase in descriptive studies. The challenge of course is to ensure that the technology is used to address interesting research questions. Effects of manipulating body mass on performance in rowing [258] and wrestling [253] were addressed and the topic of functional movement screening continues to attract interest [245, 257], although methodology in this area is highly variable.

The belief (aka **placebo**) effect was addressed in an excellent highlighted symposium. Neurobiology techniques are now being used to understand how belief influences efficacy of pain medication. Prof. Benedetti outlined a unique experimental design that uses naloxone, a drug that blocks endogenous opiate receptors. In a series of studies blinded use of naloxone prevented expected placebo effects, suggesting that expectations result in positive shifts in neurotransmitter states within the brain. Contemporary data in this area indicate that in many cases it is important for the physician (and likely the coach and sport scientist) to make sure that their client believes in treatment

strategies.

Neuromuscular **fatigue** was addressed in an interesting thematic poster session [A-27]. Researchers presenting in this session focused on manifestations of central vs peripheral fatigue. Indicators of central fatigue appear to recover quickly following exhausting exercise with measureable changes occurring within 3 min [96]. Amann's team from University of Utah are now suggesting that the central nervous system tolerates peripheral fatigue to a greater extent when group III/IV afferent feedback comes from small muscle mass [100]. Despite this finding, recovery following upper and lower body exercise to exhaustion was shown to be similar using cycling ergometry [98]. Japanese researchers addressed the effects of CO_2-enriched water on muscle recovery [97] using a well thought-out experimental design. Positive results are either artifact, placebo or real and interesting.

Concussion in sport is currently a hot topic and is now attracting interest from physicians, physiologists and sports administrators. Numerous studies were presented quantifying head trauma, describing physiological manifestation of head impact, and also documenting recovery from insult [A-31, B-29, B-68, D-51].

Thermoregulation continues to attract attention. Gastrointestinal health was compromised in both ultra-distance runners [708] and cyclists [709], and body temperature was implicated in both cases. Tyrosine ingestion produced promising cognitive results for soccer players who were asked to exercise in the heat [721].

The topic of **mobile monitoring** from a biomechanics perspective allowed four interesting researchers to address emerging technologies and methodology. Thor Besier from New Zealand is really pushing the boundaries of using inertial measurement units combined with haptic feedback to understand and then improve movement patterns. Although Thor's work is primarily focused on movement disorders, there may be application for elite sport. The ability to use technology to improve the rate of skill acquisition without creating a co-dependence on feedback will remain challenging.

High-intensity training was the topic of a thematic poster session [B-64]. Both aerobic and anaerobic fitness can improve following 6 wk of cross-fit training [1040], high blood flow stimulation aids in recovery between high intensity exercise bouts (30-s Wingate) [1042], and regulating cycling cadence can minimize fatigue for "all-out" 30-s sprints [1039].

I was involved in a symposium entitled *Unique Case Studies:* **Olympic Champions** *and the Impact of Sport Science on Performance*. A take-home message from my perspective was that there are many unique ways a sport-science team can work to improve Olympic performance; for example, skating efficiency for Dutch speed skaters, reduced risk of injury for US track and field athletes, pacing for US marathon runners, and providing general support and advice through adverse and challenging training camps for a developing Tour de France champion. Overall, helpful sport scientists work within the cultural expectations of the high-performance sporting program.

Findings from a series of unique studies focusing on the Leadville 100 **ultra-endurance** race (100 miles at 9,200-12,600 ft) indicated that human athletes are remarkable at adapting to unique environmental challenges. Athletes tend to self-regulate pacing strategies to ensure energy reserves are distributed appropriately. Cognitive aspects of the event and fatigue management present unique topics for further research. The following day Prof. Ron Maughan chaired a thematic poster session on *Endurance and the Ultra-endurance Athletes* [D-60]. Documenting nutrition strategies associated with extreme duration cycling and running events were the primary topics of interest.

A colloquium on **Deaths in Wrestling** highlighted that when it comes to elite sport what we know and what we do with the knowledge are not always connected. A tremendous amount of attention has focused on why wrestlers have died while trying to make weight, but because of the competitive nature of elite sport there will always be those who push the boundaries. Unique rules that constrain behavior are required if measures to increase safety in sport are to be adopted–especially if risky behavior is associated with winning.

A very enjoyable symposium entitled *Evidence Informed* **Sports Medicine** clearly reviewed the meaning behind many buzz words such as *evidence-based* and *objective evidence*. Practitioners from the USA, Canada and the Netherlands talked about the mystique that is associated with elite sports medicine.

Carl Foster and colleagues reviewed the topic

of **stress testing** for fitness assessment. Although they focused on clinical populations, some of the themes associated with accuracy and reliability of testing, in addition to clear definitions, were relevant for those testing elite athletes.

Some provocative concepts associated with limitations to exercise performance at **altitude** were discussed during a symposium chaired by Prof. Peter Raven on *Human Cerebral Blood Flow*. Apparently oxygenation of the brain is substantially modified by exercise, and conversely the adaptations can impact exercise performance. The altitude theme was also central to the Dill Historical Lecture presented by Prof. Benjamin Levine. The very rich history of altitude research was reviewed with an impressive collection of historical pictures. Many of the contributions made by now famous US, German, Spanish, Scandinavian and Australian researchers were acknowledged. The impact of altitude training on many physiological adaptations has now been well documented. Future topics worthy of investigation include understanding the individual variability associated with adaptations to hypoxia, and why physiological adaptations (e.g., increase in hemoglobin mass) can be uncoupled from physical and mental performance.

Epigenetics *and Exercise Adaptations* was the topic of a symposium with a keynote delivered by Prof. Mark Hargreaves. Evidence was presented that phenotype changes induced by exercise are sometimes due to chemical modifications to DNA. However, the ability for the sport scientist to act on this provocative information in a practical manner remains challenging.

Although I didn't attend, I was intrigued to see a colloquium promoting physical activity in **airports**. For all of us that travel the world with coaches and athletes the idea that physical activity can take place within an airport is relevant.

Those working with Paralympic athletes would have enjoyed the symposium chaired by Dr Walter Thompson on *Challenges in the* **Autonomic Control** *in Elite Athletes with a Physical Impairment*. This symposium addressed cardiovascular control, thermoregulation and blood-pressure themes.

Antidoping themes were discussed and reviewed by Matthew Fedoruk from the USADA. He believes that the biological passport is having very positive effects in sports like cycling with widespread doping problems. Research clarifying normal responses in elite athletes continues to be valuable for those attempting to detect abnormal physiology.

Michael Joyner from the Mayo Clinic chaired a symposium discussing the physiological and scientific aspects of a 2-h marathon [F-05]. Dr Andy Jones believes that Paula Radcliffe has already run the equivalent of a man's 2-h marathon, based on how much faster she is than all other female runners. The entire symposium presented a practical perspective to theoretical **limits of human physiology**. Why running records continue to fall with each successive generation despite similar physiological characteristics over the past five decades is an interesting question.

How the **brain** influences exercise capacity and how exercise influences the brain was the topic if a well-researched tutorial lecture delivered by Dr Romain Meeusen. Unique experimental models are revealing the role of the brain in controlling fatigue in hot conditions and at altitude.

The effects of **dehydration** on sporting performance has become controversial, as conservatives continue to warn athletes of the dangers associated with mild dehydration (~2% of body mass), whereas a bold minority point out that some of the best performing endurance athletes have the greatest dehydration after a race. Dr Kavouras chaired a symposium in which hydration experts Drs Armstrong, Casa and Spriet asserted that the evidence continues to support the advantages of hydration prior to and during endurance exercise.

As a sport scientist involved with many interdisciplinary teams, I was excited to hear insights into the much publicized Redbull Stratos project supporting Felix Baumgartner's world record free-fall **parachute jump** from the edge of the earth's atmosphere. Bottom line for a successful sport-science project: use the best people you can afford, look for genuine interest and buy-in, and make sure everyone understands their roles and responsibilities. It was clear that even aerospace engineers love a creative ambitious challenge and the chance to push boundaries. How much money did Redbull invest in this project? "A lot."

Noteworthy Abstracts

with Will Hopkins

The title of this report was inspired by my choice for the top presentation, a poster showing harmful effects of cold-water immersion on strength training. My other medal winners were also hidden in the poster ghettos: effects of a warm-up with a weighted vest on economy and performance in distance runners, and the use of baseline heart-rate variability to predict individual responses to high-intensity and high-volume endurance training. In other presentations worthy of special mention, I could find no evidence supporting the use of nitrate and carbohydrate mouth rinsing with highly trained athletes, but the taste of quinine may push sprinters to a higher level. Neuromuscular training also reduces risk of injury in team sports.

Acute Effects

Warm-up with a weighted vest improved peak running speed in an incremental test by an amazing 2.9% and running economy by 6.0% compared with no vest in a crossover with 11 well-trained **distance runners**. Relationships between change scores showed that changes in leg stiffness could explain all the improvements in performance and economy. Wow! [3528]

A high-intensity isometric **warm-up** produced a peak increase (4.9%) in maximal horizontal bat velocity 6 min later in 28 experienced female **softball** players. [932]

Various **warm-ups** increased the carry distance of the ball in a comprehensive crossover study of 30 highly proficient female **golfers**, but unfortunately the authors haven't provided enough data to assess which is likely to be best. [959]

A bench-press in the **warm-up** potentiated **shot-put** performance by 1.2% vs control, while back squat had a potentially harmful effect (-0.8%), in a crossover with 10 collegiate athletes. [2993]

Performing weighted or non-weighted box jumps with varying rest intervals as a **warm-up** did not affect vertical jump performance in 20 **recreational athletes**. [3004]

Correlates of Performance

A few of 21 **gene polymorphisms** previously associated with endurance performance also turned up as statistically significant in the comparisons of a sample of 154 competitive Japanese **endurance runners** with 649 controls, but a score representing how many such genes were present did not differ significantly between the two groups [687]. No magnitudes were shown, but with this sample size, non-significant means trivial, and even some of the significant associations may have been trivial. Conclusion: genotype screening for endurance ability is still not worthwhile.

But the presence of several **gene polymorphisms** had a moderate association with injury incidence and severity in four seasons of play by 54 male professional **soccer** players [689]. Could this finding be useful for team selection?

Two putative **gene loci** for elite sprint performance have been identified in what looks like a meta-analysis of three previous studies of Jamaicans, African-Americans and Japanese **sprinters**. [2254]

Nutrition and Drugs

"Acute supplementation with dietary **nitrate** appears to have no effect on endurance performance and adds nothing to the benefits afforded by caffeine supplementation" in this crossover study of 14 competitive **female cyclists**. Relative to placebo, the effects of caffeine alone and nitrate alone on mean power in the 20-km time trial were 5.7% (that's unusually high) and 0.0%, but the effect for caffeine plus nitrate vs placebo was apparently non-significant and wasn't shown, and of course there were no confidence limits. Louise Burke pointed out that the dose of nitrate was probably inadequate, so the way this study was reported does not provide evidence for or against the use of nitrate in highly trained athletes. [545]

"Acute [whole-body] exposure to **UVA light** has recently been shown to increase nitric oxide bioavailability", and it bestowed a presumably unclear extra 0.6% benefit to the effect of **nitrate** supplementation on 16-km time-trial time in a crossover of nine trained **cyclists**. But the effect of nitrate alone vs placebo wasn't significant and can't be estimated from the data shown. A novel approach, yes, but even if it works, it's impractical. Why not just up the dose of nitrate? [546]

In two studies of non-athletes the effects of **nitrate** (via beetroot juice) on performance were inconclusive [548, 550].

OMG, consuming beetroot juice vs **nitrate**-depleted placebo juice before a 5-km run *impaired* performance by a significant 1.6% in this double-blind crossover study of 11 male

and two female **runners**. Louise Burke: "Unless they were running up the side of Mount Everest, these aren't really runners." True, but in previous studies any beneficial effect of nitrate has tended to be greater in less trained individuals, so for me this is more evidence against prescribing nitrate for top athletes. [549]

In this crossover study of the acute (?) effect of consumption of **dark chocolate** (containing epicatechin antioxidants) vs white chocolate, nine male **participants** went 13% further in a 2-min time trial. There is no information about the dosage and timing of supplementation or the quality of the chocolate! Depending on the cycle ergometer, the enhancement in power output would be at least 13%. Too good to be true, but obviously worth further investigation. [2717]

Combined **glucose** and **fructose** ingestion produced a likely enhancement of time-trial time of 3.0% vs isocaloric high glucose but an unclear 1.2% enhancement vs moderate glucose in a crossover when eight trained male **cyclists** performed a 30-km time trial after a 2-h preload. I'd supplement with glucose plus fructose. [615]

Ingestion of **tyrosine** 5 h before a soccer-specific simulation test in the heat had a small beneficial effect on vigilance and a moderate effect on a measure of alertness in a crossover with eight recreationally active male **soccer** players. Might be worth a try, pending more evidence. [721]

Compared with control supplementation with carbohydrate, adding **protein** or **L-alanine** to the supplement tended to *impair* performance (both by 1%) of a 30-km time trial following a 120-min preload in this crossover study of four female and four male **cyclists**. [172]

Compared with placebo **mouth rinsing**, carbohydrate mouth rinsing in the fasted or fed state had negligible (0.4%) or harmful (-1.1%) effects on distance covered in a 1-h cycling time trial in a crossover with 10 male and 2 female **endurance athletes**. But the distance was only ~28 km, so either the ergometer was badly calibrated for distance or these athletes weren't cyclists [619]. A carbohydrate mouth rinse had negligible effects on a 30-min cycling time trial with 13 **active males** [620], but it resulted in a 3.6% faster time to complete a 12.8-km run in 11 **subjects**, while the run was 2.7% faster with a non-caloric sweet mouth rinse [621]. My conclusion is that mouth rinsing is likely to have negligible effects with highly trained athletes. In any case, swallow the carbohydrate to get the metabolic benefit.

Incredibly, a **mouth rinse** with a bitter-tasting quinine solution immediately before a 30-s all-out sprint improved mean power by 2.4-3.9% compared with rinsing with aspartame or water or no rinse in a crossover with 14 male **cyclists**. Partly a placebo effect? Wait and see if it declines like that of the carbohydrate mouth rinse. [618]

Ammonia inhalants don't seem to have any substantial acute effects on **explosive** [929] or **sprint** [940] performance.

Caffeine continues to benefit endurance performance acutely. There was a 3.7% reduction in swim time and a 1.3% reduction in overall performance time in actual **triathlons** when 26 triathletes consumed caffeine vs placebo (timing and dose not stated). The claim that the effect was not as pronounced as seen in previous laboratory trials seems to me to be incorrect; perhaps it relates to unstated effects in the cycle and run stages [2748]. Caffeine worked equally well in female and male **cyclists** [2755]. Caffeine had beneficial effects on intermittent **cycling** [2749] but "equivocal" effects on anaerobic performance [2751]. It looks like you might need the C allele of the cytochrome p-450 gene to benefit from caffeine [2750], but the study had only seven **participants**.

"The addition of **HMB** (beta-hydroxy-beta-methylbutyrate) and **waxy maize** to **whey protein** is able to provide additional benefits to the recovery process, evidenced by a reduction in muscle damage markers, soreness and an improvement in athletic performance." That's the reasonable conclusion in this crossover study in 13 **men** who supplemented with EAS Recovery Protein vs whey-protein control twice daily for 2 wk prior to, during, and for 2 d following a 3-d intense workout sequence. The improvements in vertical-jump power on Days 4 and 5 were 13% and 12%. That's great, but for relevance to recovery during a tournament, what really matters is effects on performance on Days 2 and 3, which apparently weren't significant. Better recovery on Days 4 and 5 is likely to mean impaired adaptation later on. [381]

Montmorency (tart) **cherry juice** vs placebo consumed 5 d prior to 3 d following a 1.8-h cycle test improved the maximum force of vol-

untary isometric contractions and reduced markers of inflammation in 16 trained male **cyclists**. So cherry juice is like other dietary antioxidants in this respect, and it may be beneficial in a tournament scenario, but does it help or harm adaptation to training? [1450, 1451]

Chocolate milk continues to be better than a carbohydrate drink for recovery, this time in **swimmers**. [623]

An extract (of roots?) of **Rhodiola crenulata** (an alpine herb high in antioxidants and used to reduce acute mountain sickness) significantly enhanced endurance performance relative to placebo in a controlled trial of 18 male **subjects** who trained for 2 wk at sea level and 2 wk at altitude, but there were no supporting data in the abstract. Use it to augment altitude training? Wait for better evidence, or do a study yourself. [2722]

Recreationally trained college-aged **males** (n=23) randomly assigned in double-blind fashion to placebo or **naproxen** treatment groups before training sessions increased their strength by 27% and 29% respectively following 6 wk of training. Evidently the anti-inflammatory drug did not attenuate adaptation to the training. The effect needs to be investigated in competitive athletes. [2719]

Training

In a controlled trial, 21 **young men** experienced in resistance training were assigned to **high-intensity resistance training** twice a week for 12 wk. One group recovered from each session with 10 min of lower-body **cold-water immersion** (10°C), while the other group performed low-intensity cycling. The cold-water immersion group experienced clear substantially less gains in most measures of strength, the differences in the changes ranging from moderate to very large. [904] Yikes! Well, it fits the new paradigm: enhance recovery and you impair adaptation.

On-court **interval training** tended to be better than off-court training for various measures of performance in this randomized controlled trial of 20 youth **tennis** players. [933]

Here's yet another study showing you can get at least as much benefit in endurance performance from low-volume high-intensity **interval training** as from high-volume endurance training, this time in a 2-wk randomized controlled trial of 15 **Gaelic footballers**. [942]

Tapering with heavy loads had a slight edge for throwing performance compared with light loads in a crossover with seven male and six female young **throwers**, and there was a clear advantage of heavy loads on measures of strength. [656]

In **accommodation resistance training**, "chains are either added on a free-weight bar and combined with traditional plates or added to the bar as the entire load." In a 4-wk randomized controlled trial with 24 **trained males**, gains were greater in the accommodation group compared with a constant-resistance group for maximal strength in the upper (16% vs 15%) and lower body (39% vs 22%), and for power in the upper (7.0% vs 4.2%) and lower body (6.6% vs 4.7%). [3335]

Neuromuscular training, according to one site, is a way to teach your body better habits for knee stability. In a meta-analysis of 23 randomized controlled trials, exercise-based interventions effective in reducing injury risk in **team sports** included multifaceted neuromuscular training and balance-board exercises. [1543] A meta-analysis of 14 randomized controlled trials supported the prophylactic effectiveness of neuromuscular training interventions to reduce ACL injury in female **soccer**. [2816]

The Brazilians have developed a system to **track training** and other aspects of their **elite athletes**: "a computational approach of SAHA system to optimal sportomic analyses." It appears to be novel and potentially valuable, but I can't understand the abstract. [3359]

A measure of **heart-rate variability** (high-frequency power?) was measured overnight at the end of 8 wk of low-intensity endurance training in 29 recreational **endurance runners**, who were then assigned in balanced fashion to either **high-intensity training** or **high-volume training** for 8 wk. The change in peak running speed in an incremental treadmill test was greater in the high intensity group (3.1% vs 0.5%). Remarkably, baseline heart-rate variability had strong correlations with the individual changes in peak speed (-0.66 in the high-intensity group, +0.61 in the high-volume group). Conclusion: "[high] training volume should be recommended for individuals with low baseline HRV while high intensity training is more suitable for individuals with high HRV." Wow! [3344]

Reviewer's Comment

with Randy Wilber

As noted in the opening paragraph of this comprehensive 2014 ACSM summary report, the number of papers, symposia, and tutorial sessions devoted to sport performance is relatively small compared to those devoted to various aspects of Exercise is Medicine, chronic disease, and clinical sports medicine. Further, the number of presentations devoted to elite sport performance is even smaller. Granted, the word *elite* implies a very small and select group, be it in reference to athletes or the sport scientists who study them from basic and applied perspectives. One of my concerns is that as many of us veteran sport scientists working with elite/Olympic athletes move into the final quarter of our careers, this trend toward fewer and fewer elite sport performance papers/presentations will continue to the point where we will no longer be seen by the ACSM Program Committee as having enough impact for inclusion on the annual meeting. As a potential action plan, I offer three strategies/recommendations:

1. If you are a sport scientist working at the elite/Olympic level (especially at the junior level), please make a concerted effort to submit your work for presentation at the ACSM Annual Meeting.

2. If you are a senior sport scientist working at the elite/Olympic level, and a long-time ACSM member, please consider seeking membership on the ACSM Program Committee, thereby serving as an advocate for elite sport performance submissions.

3. If you are a sport scientist working at the elite/Olympic level, please consider seeking membership on the ACSM Olympic/Paralympic Sports Medicine and Sport Science Committee.

In closing, I wish to thank Professor Hopkins for the opportunity to review this report, and I congratulate Louise, Jeni, David and Will on their thorough and valuable work in disseminating this information to the international sport science community. Please know that we appreciate your time and effort.

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