

Research for Athletes at the Prague Meeting of the European College of Sport Science

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Memorable features of this annual conference of ECSS were picturesque Prague, fabulous food, and impressive plenaries. [Accessing Abstracts and Videos](#): links to a search engine and downloads. [The Wow! Factor](#): the six best presentations for sport. [Acute Effects](#): circadian rhythm; sleep; warm-up in soccer; post-activation potentiation in basketball; vibration and stretching in badminton; taping in tennis and golf; cooling in tennis and swimming; recovery in various sports. [Injury and Health](#): brain injury in NFL and school rugby; tackling technique and instrumented mouth guard in rugby; biomechanics of baseball pitching; acute-to-chronic workload in football; hip imbalance in football; taping in volleyball; leg stiffness in soccer; ankle instability and sprains; nutrition and management of return to training; resistance training, rehab and genes in ACL patients; Canadian Active & Safe program; mental health. [Nutrition](#): high carbs vs fat; ketone ester for over-reaching; Chinese herbal in rats; flavonoid in cyclists; cherry juice in soccer; gelatin with resistance training; vitamin D; carnosine plus anserine; caffeine; quinine; nitrate at altitude; footballers' cuisine. [Performance Analysis](#): aerodynamics of speed skaters; biomechanics of sprinting; correlates of sprinting; joint movements in baseball throwing; height of rowers; team-work in Aussie football; small-sided soccer games; winners in soccer; stroke rate in rowing; breakpoints in tennis; playing together in rugby; high-speed distance in women's football; positional activity in soccer and rugby league. [Talent Identification and Development](#): self-regulation; biological age, birthday- and bio-banding in various sports; supportive environment in track and field; psych skills and pedagogy for coaches; fitness tests in female soccer; progression in cyclists, taekwondo and rowers; pacing in speed skaters; Japanese and other genotypes. [Tests and Technology](#): crowd-sourcing; magnetic-resonance spectroscopy; muscle feedback in a cyclist; LEDs for pacing swimmers; monitoring sleep; apps for kinematics and sprint times; mechanical rower; ball-passing machine; padded cycling shorts; vertical jump assessment; Xsens motion capture; passing test in soccer; fat oxidation; lactate threshold in skiers; prescribing interval intensity in cyclists; kayak test; submax testing for Ironman training; accumulated workload. [Training](#): core for swimmers; intervals and periodization for endurance and soccer; over-reaching in runners; sprinting for cyclists; resistance or strength for various sports; altitude for swimmers; hypoxia for runners; heat for various sports. KEYWORDS: competition, elite athletes, ergogenic aids, injury, monitoring, nutrition, performance, talent identification, technology, tests, training.

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This year's annual meeting of ECSS was in picturesque Prague, July 3-6, coinciding with a week of glorious sunshine. I arrived on the Saturday to settle in and see the sights, best of which for the outdoors-inclined was Divoká Šárka ("Wild Park"), on the outskirts of Prague opposite the Faculty of Physical Education and Sport

of Charles University, the host institution for the conference.

The Prague Congress Center on the other side of the city was great, in spite of being a relic of Soviet occupation. The food was the best yet for quality and quantity—I had to temporarily abandon my daytime fasting regime—and the party on

the Friday night was a deafening success, with the high density of attendees facilitating many meaningful and meaningless interactions. A huge thank-you to the conference president Prof. Václav Bunc, to Marie Skalská and the team from the Faculty who helped organize a great program, to front-man Tomáš Brtník and his team of volunteers, to Joan Duda for all the officiating in her two years as ECSS president, and to the local and ECSS committees and office staff who processed 870 presentations and more than 2700 registrants. When they become available, I will add links here to the official debrief, the young-investigator awards, the GSSI nutrition awards, the best articles in *European Journal of Sport Science*, and the conference picture gallery.

Alas, European inclusiveness did not extend to proportional representation of sport performance in the list of finalists for the young-investigator awards in this and most previous years. When it comes to recognition of young investigators, ECSS seems to be more a college of exercise science. That said, three of the four plenaries were relevant to competitive athletes, thank you.

This year the 5-min mini-orals were replaced with 20 parallel sessions of 5-min conventional chaired posters, and for the first time each session had a microphone linked to multiple headsets. It worked: you could hear the chair, the presenter, and questions from the audience, and it was easy to wander to another session and change the channel on the headset. Mini-orals are history, which should please some PhDs at the German Sport University I visited in Cologne the day before the conference: they felt that giving a mini-oral was not worth the cost of registration. Will they be satisfied with chaired posters? Reviewer's comment: I presented in a chaired-poster session and found it marginally better than a mini-oral, but still too short. Perhaps just open posters (ACSM format) are the best? There was also some poor scheduling this year, at least for metabolism sessions. Common themes should be in series, not parallel!

The conference package included a free pass for the excellent public transport system of metro, trams and buses, but the pass ended on the last day of the conference, so it wasn't much use for conscientious attendees. Maybe that's why some of the plenaries and the closing ceremony were poorly attended. [Next year's conference](#) will be in Seville, July 1-3, and it will end on the

Friday evening. Plan to go, and please plan to attend full-time for the three days! See Seville before or after the conference. Bring shorts and a sunhat.

Following the recent attacks on magnitude-based inference (MBI), and in spite of the recent call in *Nature* to retire statistical significance (Amrhein et al., 2019), many presenters had scuttled back to traditional p values and their two worst misinterpretations: non-significance means no effect, and a difference in significance amounts to a significant difference. An explication of MBI as a decision method congruent with inferiority hypothesis testing and its well-defined acceptable error rates is forthcoming. Here's hoping it will persuade researchers once and for all to abandon null-hypothesis significance testing based on the traditional p value in favor of honest, practical and theoretically sound magnitude-based decisions.

Accessing Abstracts and Videos

As in my previous reports, I have focused on performance of competitive athletes. ECSS is, of course, much more, and this year Ross Neville will again report on physical activity and education of children. Watch for his report at this site. A proposed report on activity in adults will not eventuate this year, sadly.

To find abstracts in your area of interest, go to the [program page](#) at the [Prague conference site](#), where you can link to pages for each tier of presentation. Or download PDFs of the [full program](#) and the [full book of abstracts](#). To find the presentations I have reviewed, copy the presenter's name and initials shown in brackets [...] into the [search engine](#), or if you have downloaded the PDF of the abstracts, copy into the advanced search form (Ctrl-Shift-F) in the Adobe Acrobat PDF reader. Abstracts for this conference will eventually join those of previous conferences in the [EDSS database](#) (login required). If you want to contact an author, you will have to try googling for an email address, because ECSS no longer provides email access to members, owing to privacy concerns.

My apologies if you can't find your presentation in this report. Amongst the reasons I may have omitted yours: it was too difficult to understand (often because of an impenetrable thicket of abbreviations—they should be banned outright); the sample size was inadequate (e.g., less than 10 subjects per group); there was little or no relevance to competitive athletes; there were no

data at all; performance outcomes were expressed as standardized effects, R-squareds or p values, instead of percents or other meaningful practical units; the focus was mechanistic, with no practical application; and crucial methodology was not stated.

In nine full days of working through the book of abstracts, I am bound to have missed some with useful information for competitive athletes, especially in sports that I am not familiar with. So I suggest you search the abstracts in the PDF using your sport or topic of interest as the key word in the advanced-find window. (Do it in a small group for more value and fun. Use this report for a conference de-brief, too.) If you are an author of a missing abstract that you think should be in this report, or if I have got something wrong, please get back to me ASAP and I will augment or amend this report accordingly.

Videos of plenaries and some invited symposia were live streamed, and the recordings are [available here](#) (in approximately reverse temporal order). I searched in vain for this link at the ECSS site, and I found it otherwise only by accident. Amongst the videos is a moving [memorial tribute](#) to the recently deceased Paavo Komi.

The Wow Factor

This year there were five more than my smallest important threshold of one presentation worthy of a **Wow!** to make the conference (and this report) worthwhile for athletes. Here they are, in order of appearance below: [circadian phenotypes](#) and performance; [sleep](#) for elite athletes; [brain injuries](#) in American football and school rugby; [high carb vs high fat](#) for endurance; [aerodynamics](#) of speed skaters; and [core training](#) for swimmers.

Concerning the other end of the quality dimension, once again the reviewer of this article commented that some abstracts would not have made the grade for the ACSM meeting. ECSS should have some guidelines for best practice in writing abstracts of qualitative and quantitative studies. Guidelines for abstracts of symposia might also help: too many of these were of the "findings and recommendations will be presented" variety. As I stated last year, if we're going to have abstracts, we should be proud of them. Reviewer's comment: offer authors of below-par abstracts the opportunity to resubmit?

Acute Effects

Wow! In the plenary on **circadian control** of diurnal performance patterns in **athletes**, Roland

Brandstaetter presented evidence that peak performance occurs at midday in early circadian phenotypes ("larks"), in the afternoon in intermediate circadian phenotypes, and in the evening in late circadian phenotypes ("owls"). Reductions in performance off the peak are dramatic, so he has developed "non-photic" phase-shifting interventions to adjust an athlete's circadian phenotype (chronotype) to competition times. [BRANDSTAETTER, R.]. He did not elaborate on the interventions nor state why he doesn't use light, and I could find no published evidence of his interventions when I did a Google-Scholar search for his name and "circadian". I guess you have pay to find out more, because he has gone private with a consultancy he calls [Clockwise](#): see [this link](#) for athletes in English; the Clockwise site is otherwise mainly in German. His talk is available on [this video](#), which begins with Karyn Esser's excellent plenary presentation on mechanisms of circadian rhythms in muscle. You can find links to Brandstaetter's two articles on circadian rhythms in athletic performance at [this link](#).

Here's a study providing evidence of substantial individual differences in the **time of day** of best performance of isometric and isokinetic leg and arm strength of 19 **male athletes**. [KNAIER, R.]. The authors need a mixed model that properly captures the individual differences.

There's an impenetrable barrier of abbreviations in this abstract about a new questionnaire to determine where an athlete resides on the **lark-owl chronotype** continuum. It appears to be better than the current gold standard questionnaire, when compared with the criterion of dim light melatonin onset. [RYAN, R.]

Wow! Her abstract is uninformative [HALSON, S.], but watch Shona in [the video](#) of the symposium on optimizing recovery from the 54th min on for answers to the following questions on **sleep** for **elite athletes**... **Is sleep important?** Yes, in two correlational studies of competitive performance, and numerous studies on cognitive performance. **How much do they get?** 6.5 to 7 h, with SD ~1.2 h, which is less than age-matched non-athletes. **What disturbs their sleep?** The earlier the training start time, the less sleep: they don't go to bed early enough. Also night competitions, social media and 12 other factors! **What's the best way to measure it?** Polysomnography is the gold standard for one-off assessments if a clinical problem is suspected. Otherwise validated activity monitors:

Philips Actiwatch, Fatigue Science. Fitbit and Whoop are not quite as good. "Nearable" devices are questionable. Questionnaires and diaries need to be athlete-specific. **How do we improve it?** Cool, dark, quiet bedroom; comfortable bedding and clothing; limited caffeine late afternoon; brief suitably scheduled naps; avoid sloth on off days; consistent sleep/wake pattern; non-stimulating pre-bed routine; avoid using devices 30 min pre-bed. But effecting long-term change requires strategies informed by behavioral science. View the video from 72 min to see her approach with individual athletes. In question time, she wouldn't be drawn on specific nutritional advice.

"**Dietary factors** including the timing of evening meals, daily energy and protein intake and evening sugar intake" were associated with various measures of **sleep** time in a 10-d study of 36 **elite Australian-rules football** players. [CONDO, D.]

A CO₂-aerated bath improved several measures of **sleep** in eight **college elite swimmers** compared with a control bath. [WADA, T.]

When 15 female **youth soccer** players **warmed up**, a passive recovery period of 10 min impaired 20-m sprint performance by ~5%. "Athletes are recommended to apply additional warm-up methods 2-5 minutes prior to the start of the performance." [KAWATA, F.]

In a study of **post-activation potentiation** with 26 **male basketball** players, three sets of six reps of squat jumps performed with 20-s rests every two reps rather than no rests resulted in ~1.0-1.5 cm greater jump height 4 and 8 min later. [DELLO IACONO, A.]

Addition of **vibration rolling** to **dynamic stretching** increased agility and balance in a crossover study of 40 **college badminton** team students. [LIN, W.]

Kinesio tape on quads and gastrocs increased countermovement jump height by 7.0% in 66 **junior tennis** players. [ULUSOY, B.]. It also increased flight time by 7.7%, but according to kinetics and calculus, percent change in flight time should be half that of height.

P value only, but it's worth including this abstract. "Applying **elastic taping** on the internal and external oblique abdominal muscles led to significant changes in the distance and accuracy of the drive shots by eight **professional golfers** ($p < 0.05$). Elastic taping is expected to be an effective training (?) intervention." [KIM, J.W.]

Eight competitive **male tennis** players used

cooling strategies (cold drink, fan, ice-filled damp towel) or no cooling in crossover fashion in a 90-min standardized tennis match at 32 °C and 49% relative humidity. Cooling had "no effect on tennis performance, physiological measures of heat strain, or perception of effort, although heart rate recovery and ratings of well-being were improved. Blood lactate concentration was higher in the cooling condition. Consequently, it is possible that the players who felt less fatigued and better recovered due to cooling pushed themselves harder." [WIEWELHOVE, T.]. Caution: $p > 0.05$ only.

Consumption of an **ice slurry** vs a tepid fluid 20 min before a 750-m freestyle **swim** reduced swim time by 0.9% in a crossover of seven **male athletes**, a potentially beneficial effect for a triathlon. [NAKASHIMA, D.]

The abstracts of the first two speakers in the symposium on **recovery** of exercise performance are not particularly informative. [WESTERBLAD, H.; WALLIS, G.]. Here is a summary from [the video](#). The first speaker focused on mechanisms in a mouse model. The second speaker showed that **fructose** added to **glucose** enhanced recovery for endurance performance in one published study but not in a recent one with **cyclists** (although the exercise protocol was hardly relevant to such athletes, and sample size was only 8).

In the following three original-research presentations of successful strategies for acute **recovery**, be aware that chronic use (effects of which were not reported) may be counterproductive.

It was assessed as differences in p-value inequalities, but in a crossover study of 16 **youth swimmers** (8 F, 8 M), a second 100-m swim ~18 min after a first swim was slower than the first by 0.8%, 0.9%, 1.3% and 2.5% for **thera-band**, intermittent in-water, passive rest and continuous in-water **recovery**, respectively. "In the absence of a cool-down pool, swimmers may consider stroke-specific **thera-band exercises** as a more effective recovery strategy than passive rest." [TAYLOR, D.]. But 18 min is too short for repeated performance in heats and semis and too long for repeated sprints in training.

Compared with 10 min of **cold-water immersion** or passive rest, **massage** for 40 min resulted in improved running economy a day after an exhaustive run in a controlled trial of 48 well-trained **male runners**. [DUÑABEITIA, I.]. I can't understand the effect statistic. Percents,

please!

Cow's **milk**, goat's milk and a whey-protein drink were generally better than **carbohydrate** for **recovery** up to 72 h after "a sprinting and jumping protocol" in a controlled trial of 4x 8 **team-sport athletes**. [CURRISTIN, M.]

A **carbohydrate drink** after glycogen-depleting exercise *impaired* performance of eight **trained males** by 12% in a ~10-min time-to-exhaustion test 2 h later. The authors attributed the effect to insulin and autonomic nervous system. [TSUKAMOTO, M.]. The impairment is equivalent to a bit less than 1% in a time trial.

And here's a study where at least a start was made on looking at the chronic effect of a **recovery** strategy. Twelve **males** performed 7 sessions of **resistance exercise** over 2 wk, each followed by immersion of one leg in **cold water** (8 °C) and the other in thermoneutral water (30 °C). Both legs showed a 12% improvement in leg-extension 1-RM strength, but the cold leg showed 12% less myofibrillar protein synthesis in tracer-laced biopsies. [FUCHS, C.J.]. You can bet that over a longer period, the relatively lower protein synthesis would result in less gain in muscle mass and strength.

Injury and Health

Wow! The plenary was titled "Sport and **brain injuries** - A red flag for sport?" [MCKEE, A.; ANDERSON, E.]. After hearing Ann McKee's impassioned account of the brain pathology of American (NFL) footballers, and then watching Eric Anderson's stunning silent slideshow presenting school rugby in the UK as institutionalized child abuse, I was convinced that tackling would have to be banned from contact sports. View [the video](#) and you will be, too. My thanks go to a colleague for alerting me to epidemiological evidence not presented by these charismatic speakers that paints a less disturbing picture. For example, a recent retrospective cohort study showed a ~3.0× higher risk of death from "neurodegenerative disease as an underlying or contributing cause" in American football compared with baseball, a non-contact sport (Nguyen et al., 2019). But less than 10% of deaths in the two cohorts were attributed to neurodegenerative disease, and all-cause mortality in NFL players in another study was half the US national average (Lehman et al., 2012). "Put another way, if [American] football were viewed as a drug, it saved 296 lives but at the cost of 17 deaths [in the cohort of 3349 players]" as stated in an edi-

torial commentary (Carson, 2017) accompanying other articles showing "no significant effects of concussion" on health of retired rugby and ice-hockey players. Be that as it may, once there is sufficient evidence that tackling in a sport increases the risk of even a relatively rare neurological disease, the sport will face class-action lawsuits from players or their bereaved families, if it does not acknowledge the risk and make playing safer. The same goes for heading the ball in soccer.

Response to the call to ban **tackling** from **school rugby** in the UK: "Government officials conflate the benefit of physical activity with the benefits of sport/rugby, they divert onto other issues (such as physical inactivity), they delay through substandard initiatives, they dismiss the evidence, they defame public health advocates, and they devolve themselves of responsibility." [WHITE, A.J.]. Yes, but what is the effect of playing school rugby on long-term cognitive function and mortality?

"This study showed that technical feedback and instruction using video improved **tackling technique** of **rugby union** players..., with the ultimate goal of reducing the risk of injury." [DAVIDOW, D.].

Linear and rotational accelerations recorded from an **instrumented mouth guard** in **rugby-union** players were orders of magnitude lower than published values recorded from (loose) head- or helmet-mounted sensors in other sports. The instrumented mouth guard is evidently the right technology to study and reduce **head impacts** in sport. [WILLIAMS, E.M.P.]

Two **biomechanical** studies of **baseball pitchers** might be useful for reducing injuries in these athletes [TSENG, T.; YEH, H.]

The authors claim that "the ability of cumulative, coupled, uncoupled and exponentially weighted **external-load acute-to-chronic ratios** to differentiate between injury type is poor", but with only 124 injuries in the analysis of 192 **professional football** players, "p>0.05" means "there is a need for larger studies". [ENRIGHT, K.]

"**Hip abduction strength imbalance** favoring the preferred kicking limb, and a higher score indicative of better hip/groin health obtained at pre-season, reduced the likelihood of subsequent hip/groin injury" in 204 **elite male football** players from ten professional clubs, 24 of whom experienced at least one hip/groin injury. [BOURNE, M.]

"The application of **dynamic taping** had a profound influence on decreasing frontal plane knee projection angle during drop landing and drop jumping" in this crossover study of 13 **female volleyball** athletes. "The effects might reduce the risk of **lower-limb injuries** in volleyball athletes." [LIN, C.F.]

"**Leg stiffness** remained compromised 8 d post-competitive match-play in all age groups" as were some measures of performance in this study of 33 **youth female soccer** players aged 12-17 years. "The reduction in leg stiffness at training sessions and subsequently before the next competitive match may have implications for sprint and jump performance and injury risk." [HUGHES, J.D.]

The abstracts from a symposium on **ankle instability** and **ankle sprains** contain some useful information. [GEHRING, D., DELAHUNT, E., LOHRER, H.]. No video. See also a review of literature on return to play following ankle injury. [TASSIGNON, B.]

Longer **joint mobilization** treatment was more effective on dynamic balance in a controlled trial of 48 **female athletes** with chronic **ankle instability**. [HOLLAND, C.J.]

This abstract contains specific advice on **nutritional strategies** for **athletes** recovering from injury in relation to energy demands, muscle atrophy, muscle repair, and body composition. [CLOSE, G.L.]

I missed the symposium on **management of return to training** following injury. The abstracts are not very helpful [DRUST, B.; HARLEY, J.; MEYER, T.], but [the video](#) is bound to be for physicians, physios and trainers.

Resistance training with blood-flow restriction produced a greater reduction in knee-joint pain and greater improvements in physical function than traditional heavy-load resistance training in a randomized controlled trial of 24 **patients** recovering from **ACL reconstruction**. [HUGHES, L.]

These two abstracts should also be useful for rehabilitation of **athletes** following **ACL surgery**: [HARPUR, G.; MINSHULL, C.]

A case-control (249 vs 92) study of **anterior cruciate ligament (ACL) injuries** identified **polymorphisms** of two genes associated with injury that are "pivotal to the development, integrity and healing of connective tissues and therefore represent potential targets for therapeutic interventions." [SEPTEMBER, A.V.]. Similar studies on ACL injury from the same

group identified genes in the inflammatory pathway [SUIJKERBUIJK, M.] and in the proteoglycan and angiogenesis pathways. [FELDMANN, D.C.]

[Active & Safe](#) is an **on-line platform** and resource for **injury prevention** in **sport** and **recreation** in Canada. This abstract describes only its development. [PIKE, I.]

From a symposium on **athletes' mental health** (no video)... "Stressors within the sport (e.g., pressure to perform well) have the most negative impact" on **depression** [NIXDORF, I.]. "The co-benefits of **nature contact** in terms of **team cohesion**, pro-social behavior and environmental awareness are of significance for athletes" [MACINTYRE, T.]. The third speaker's abstract is minimally informative [MADIGAN, D.]. The reviewer attended the session and heard that intervening to reduce **perfectionism** may attenuate symptoms of **burnout**, but the associated effects on performance have not been addressed.

Nutrition

Wow! Neither I nor the reviewer was able to attend the symposium on high **carbohydrate** vs high **fat** for **endurance** performance. Herewith is a summary of the abstracts and [video](#). "Fat-rich diets do not improve training capacity or performance in endurance events lasting up to 3 h" [HAWLEY, J.]. John's talk was presented by David Bishop. In his view, do your high intensity training on high carbs, but there may be some value sometimes in following with a low-carb meal, sleeping low, then doing low intensity training, perhaps split into two bouts. Delaying a post-exercise [high-carb?] meal might also be beneficial. The second speaker, Jørn Helge, presented evidence of an "association, albeit not very strong, between Ironman triathlon performance and maximal fat oxidation." [HELGE, J.]. He deflected a question on the effect of a ketogenic (high-fat) diet on endurance performance to the third speaker, Louise Burke. Her abstract is minimally informative [BURKE, L.], but she gave a clear Wow! talk on the "Supernova" studies of racewalkers at the Australian Institute of Sport. In summary, low-carb high-fat diets produce higher fat oxidation in ~5 d, but they reduce carb oxidation when it is available ("reduce metabolic flexibility") and thereby "reduce capacity for higher intensity aerobic performance" (Olympic events). "Options for periodization with high carb availability are challenging", as shown by possibly better performance with

straight high carb in her studies. She did not address ultra-endurance. In response to a question about individual responses, she said that in the latest study, all the athletes got better on the carb diet, but only one of seven got better (slightly) on the ketogenic diet. Response to a question on ketone supplementation: unclear effect, but "getting the dosage right and overcoming any gastro symptoms are probably important parts of whether it works or not."

Keep tabs on publication of this (placebo?) controlled trial, in which "fit **male subjects** participated in two daily cycling sessions (3 wk, 6 d/wk) while receiving either a **ketone ester** drink (n=9) or a control drink (n=9) following each session." The control drink was not described. The ketone ester "inhibited the development of **overreaching** symptoms during a period of strenuous endurance training", and the cytokine GDF15 was a potential marker of overreaching. [POFFÉ, C.]

It was only **rats** of unstated sex, and the effects on strength and endurance weren't differentiated in the abstract, but a **Chinese herbal decoction** (danggui buxue tang) supplementation for 21 d "augments physical performance and facilitates physiological adaptations in swimming rats." The active ingredient appears to be a **phytoestrogen**. [CHANG, C.W.]

In this randomized controlled trial of 40 **cyclists**, those ingesting 500 mg of Cardiose® (**2S-hesperidin**, a flavonoid found in citrus fruit) daily for 8 wk improved power at VO₂max and body-fat mass compared with placebo. P values only. [MARTÍNEZ-NOGUERA, F.J.]

"**Tart cherry juice** has no effect on muscle function loss or muscle soreness following a **soccer** match" in a double-blind crossover with 10 professional players. [CLIFFORD, T.]. Yes, but the conclusion is based on p values. On cherry juice, they ran 5% further in the match, and there was 3.9% less decrement in reactive strength index at one time point post-match. This study does not exclude the possibility of benefit from cherry juice. Wouldn't *unclear* be a better conclusion?

It might be worth supplementing daily with collagen hydrolysate (**gelatin**), judging by the increases in fat-free mass and squat 1RM and effects on the proteome in this placebo-controlled trial of 12 wk of resistance training with 57 **young men**. [KIRMSE, M.; OERTZEN-HAGEMANN, V.]

It was a controlled trial of only 7+7 **collegiate**

female volleyball players, but 4 wk of daily **vitamin D** supplementation (2000 IU) enhanced jump height and triple-jump distance (by 2.8 cm and 14 cm) compared with placebo. Season of year was not stated. [LIU, Y.H.]

In a double-blind randomized controlled trial of **trained persons** receiving daily **vitamin D** (n=29) or placebo (n=24) while they continued usual training for 12 wk of the Norwegian winter, there was zero difference in the change in maximal strength and practically zero in myosin gene expression, but a 9.4% increase in overall muscle endurance (reps to failure), albeit with considerable uncertainty. "One might not exclude an effect at the protein level" was the sensible conclusion. [NYGAARD, H.]

A novel strategy to increase muscle carnosine content rapidly using an acute supplement of **carnosine** and **anserine** improved 5-s Wingate cycling peak power by 6% in a crossover of 18 **men**. [BLANCQUAERT, L.]. This won the GSSI industry award, as announced [on this video](#). In other studies by the same group, mean power in three Wingate tests improved by 3% and there was an improvement in p values for peak power. [DE JAGER, S.]

Caffeinated gum reduced 50-m swim time by 1.8% and 10 reps of 200 m by 1.4% in a double-blind crossover with 10 trained **swimmers**. [GUGLIELMO, L.G.A.]

"A 4 mg·kg⁻¹ dose of **caffeine** enhances maximal strength, power and muscular endurance in **resistance-trained females**. This moderate dose may reduce the negative side effects that have been described previously with higher doses." [RISVANG, L.]

"Ingesting 2 mM of **quinine** during the last stage of a 3-km time trial does not improve cycling performance" in a crossover of 12 trained **male cyclists**. [ETXEBARRIA, N.]

Highly trained endurance athletes get little or no performance benefit from nitrate supplementation, but what about if oxygen delivery is compromised when competing at altitude? The reviewer and I missed the symposium on **dietary nitrate and hypoxia**, so I viewed [the video](#) to check assertions in the abstracts. "Nitrate supplementation considerably enhances exercise tolerance in moderate hypoxia" [VANHATALO, A.]. Video: in the studies to date the findings are inconsistent for trained athletes with acute or chronic nitrate supplementation. "Dietary nitrate has recently been proposed as a potential strat-

egy to attenuate hypoxia-induced cognitive dysfunction and altitude illness" [SHANNON, O.M.]. Video: at present there is some evidence that nitrate does not improve cognitive function and does not decrease acute mountain sickness. "Dietary nitrate may dampen the hypoxic-induced exercise intolerance and improve performance" [PORCELLI, S.]. Video: in his recent unpublished study, there is benefit only for individuals with low VO₂max. In question time Phil Ainslie said that in a recent unpublished meta-analysis cognitive function is a "mixed bag" and is not clearly impaired at moderate altitude.

The sports-nutrition interest-group meeting featured a recorded presentation by Tom Parry, the inspirational nutritionist for the Manchester City **football** team, showing the heights of sport-specific **cuisine** that can be achieved in a professional sport with money to buy the food, the chefs, and Tom. Sorry, no abstract or links.

Performance Analysis

Wow! If you want to improve the performance of your team-pursuit **speed skaters**, read this abstract, based on wind-tunnel experiments and position measurements, to get the **aerodynamics** right. "Team Japan excels in it, compared to the other teams." [KOBAY, H.]. Relevant for **team cyclists**, too? Reviewer: yes!

In the plenary on **biomechanics of sprinting**, Ako Salo made the point that biomechanical analyses in the past have provided suggestions for improving performance by changing one parameter, but the method is not particularly successful, because other parameters change in parallel. Biomechanists are still a few years away from being able to make better prescriptions. We also lack and will need longitudinal studies of how to improve technique and performance, especially with elite athletes. [SALO, A.I.T.]. Glen Lichtwark's presentation was all mechanistic. He concluded that it's so complicated that only forthcoming predictive models and simulations that account for neural control, physiology and mechanics will provide prescriptions aimed at optimizing performance. [LICHTWARK, G.]. Abstracts and the [video](#) are not particularly specific about performance.

Correlations between sprint speed and **hip extensor muscles** of 26 **male sprinters** "suggest that resistance training aimed at hypertrophy of semimembranosus and semitendinosus muscles may be beneficial in the early acceleration phase and from the maximal velocity to the deceleration phases of the 100-m sprint, respectively."

[TAKAHASHI, K.]

This study of throwing by 15 right-handed **baseball throwers** identified "interrelationships between **joint movements** that are important to maintain the precision of performance during throwing." [KIMURA, A.]

In an analysis of **heights** of 2128 world-champs **rowing** finalists, the tallest quartile in men's single sculls were 4.2% faster than the second (and other?) quartiles. "For other Olympic categories the relationship between speed and morphological factors is more ambiguous." [DELAROCHELAMBERT, Q.]

Analysis of eight seasons of player positional data of the **Australian Football** League produced five **team-work measures** that all showed significant differences between winning and losing teams and high correlations with score margin. "AFL teams should aim to maximize their effective disposal count with an even contribution from all players." [YOUNG, C.]

Small-sided games (5v5 on fields of three sizes) weren't as **intense** as high-intensity intervals for 10 **young soccer** players. Use intervals to improve aerobic capacity; use games to improve technique. [MASSAMBA, A.]

Tactical efficiency in **small-sided games** seems to be a useful measure for 76 **youth male soccer** players. I gave up on trying to understand the statistics. [BAGATIN, R.]

In an analysis of match **performance indicators** of 24 teams in 51 matches, "goal attempts, ball possession and pass success have constituted the victory for the winning teams in Asian **soccer** cup." [GONG, B.N.]

Stroke rate has increased lately in **world-class rowing** events. [ALTMANN, K.]

Analysis of 2,699 **breakpoints** played by 121 **male tennis** players from 2017-18 US Open identified various predictors of winning the breakpoint by the serving or returning player. [CUI, Y.]. Would the same predictors apply to winning any set?

Cumulative shared selections, a measure of how often players played matches with the same players, was a predictor of performance of the ten-nations teams in **rugby world-cup** matches. [SAULIÈRE, G.]

From a comparison of 15 **women's collegiate division-2 football** matches with 56 **world-cup** matches, "we could hypothesize that increasing the amount of **high-speed distance** relative to total distance would produce improvements in division-2 performance." [ANDERSEN, J.C.]

Here are two presentations on **playing-position** differences in **activity** in team sports. I may have missed others. "Central attacking midfielders and central midfielders had greater **activity profiles** compared to the other position groups" in videos of 96 **soccer** matches of the German Bundesliga analyzed by an automatic player detection and tracking system. [VENZKE, J.]. In a GPS study of an under-16 and under-18 **rugby league** team for one season, "the limited differences in peak **running intensity** between positional groups and age groups suggest a broad range of elite youth rugby league athletes can receive similar training stimuli." [SMITH, M.R.]

Talent Identification and Development

In an invited symposium on advances in **athlete development research**, the chair, Stephen Copley, pointed out that most research is mono-disciplinary, univariate and cross-sectional. The first speaker, Marije Elferink-Gemser, presented an exception: the Groningen talent studies. In over 20 years of studies, the most important (though not a strong) predictor of future performance is **self-regulation** of learning, which is characterized by knowing what to do, how to do it, being motivated to improve, and being the director of own development. Coaches should foster self-regulation socratically, by asking questions. [ELFERINK-GEMSER, M.]. The second speaker focused more on identifying the physical performance characteristics of academy **rugby-league** players that predict future professional status, emphasizing the importance of adjustment for **biological age**. [TILL, K.]. The chair returned to the podium to present ways to track anthropometric and fitness measures using z scores, radar plots, and software that uses quadratic age trajectories to adjust for the **relative-age effect** (under-representation of younger kids in a calendar-age cohort). [COBLEY, S.]. [View the video.](#)

The above software was shown to work well on the **relative-age effect** of several thousand **female age-group swimmers**. "Removing the influence of age differences might help improve the accuracy of identifying genuinely skilled youth swimmers." [ABBOTT, S.]

"England **Squash** adopted a '**birthday banding**' approach to their talent pathway, whereby young athletes move up to their next birthdate group on their birthday." Younger kids are now a little *over*-represented in the age groups. [JEFFREYS, M.]

Sixty-one male and two female **youth elite**

soccer players played two matches in bio-banded (biological) age groups and two matches in usual age groups. "**Bio-banding** created a more balanced and competitive match play and possibly results in a better environment for the development of talented players. Bio-banding could help to detect potential future champions." [LÜDIN, D.]

On the other hand, there was little difference in "locomotor and technical variables" between **bio-banded** and age-group **small-sided games** (5 each of 5-min 4 vs 4) with 12 **elite youth male soccer** players (U12s to U15s). Heart rates were lower in the bio-banded games, so "the challenge point may become too low and bio-banding may not stimulate the enhancement of physical outputs." [SMITH, J.A.]

"**Talent development environments** that were perceived as **supportive**, with clearly outlined goals, and a long-term development focus were associated with better athlete wellbeing and lower reported burnout" in a survey of 400 talented Caribbean **youth track and field** athletes. [THOMAS, C.E.]

Ten **coaches** of **rowing, canoeing and track and field** spent 10 sessions with a sport psychologists aimed at coach delivery of **psychological skills training** of their athletes. The coaches appeared to be very satisfied with the process. [JAENES SÁNCHEZ, J.C.]

Fifteen **coaches** of **individual and team sports** who had adopted a "contemporary **pedagogical approach** to coaching (a non-linear, individualized, adaptive approach, emphasizing representative learning designs)" reported "resistance from stakeholders (athletes, parents, sports). However, coaches continued to use this approach and expressed how positive reactions emerged over time with effective communication with stakeholders being critical for acceptance of their model of learning." [STONE, J.A.]

I guess it was the authors' way of avoiding logistic regression, but it's confusing (for me) to back-predict age-dependent changes in **fitness tests** with the level that the 737 **female youth soccer** players eventually reached (first vs lower levels of the German professional league). And the effects were reported only as $p < 0.05$. Sigh. [LEYHR, D.]

Performance in the **under-15** and **under-17** national levels (614 **cyclists**) had little relationship with reaching the **elite senior** level (54 cyclists). "In younger athletes, the focus should not

be on competitive performance to estimate future potential." [MOSTAERT, M.]

"Eighteen **elite taekwondo** athletes scored better compared to 80 **non-elites** on body composition (fat percentage), sprint speed, lower limb explosivity, and general body coordination." [NORJALI WAZIR, M.]. I have missed some abstracts like this one, comparing competitive levels of athletes.

Ten male **Olympic medalist rowers** in double sculls or quadruple four performed a 2000-m Concept-2 time trial in 5:50 to 5:57 at **age 14 y** and improved by 5-6% by **age 21-23 y**. [MÄESTU, J.]

In **rowing**, only about one-third of finalists in **junior world championships** "make the leap to world championships or **Olympics**, so it's important to allow for late developers and transfers from other sports. [HOFFMANN, A.]

These abstracts describe the development of **pacing** in **junior elite speed skaters**. [STOTER, I.K.; MENTING, S.G.P.]

"The ACTN3 R577X **genotype** frequencies are associated with sport event in 907 **elite** Japanese **athletes**, especially in sprint/power sport, which is demonstrated high frequency of RR+RX genotype." [AKAZAWA, N.].

Other effects of **genotypes**: on **iron uptake** in **athletes** [WANG, C.]; on **vitamin-D** status and performance [KRASNIQI, E.]; on effect of **training** in **non-athletes** [GOLEVA-FJELLET, S.]; on **athletes** vs non-athletes [FLÜCK, M.]; and on no difference between **rugby forwards and backs** [PASQUALETTI, M.].

Tests and Technology

The question addressed at the pre-conference meeting of the elite performance interest group was "can we **crowd-source impactful research** in applied sport science?" That is, can we use the training and self-test performance data from wearable technologies of thousands of volunteers? My impression from the presentations? No, because of insuperable problems with missing, messy and predominantly **non-elite** data. There was an off-the-topic presentation on the potentially more successful use of publicly available competitive performance data to flag large and unexpected improvements in performance of individual athletes for further investigation as possible instances of abuse of **banned substances** or doping.

Read this particularly informative symposium abstract about the limitations and applications of **magnetic-resonance spectroscopy**, "a powerful

tool for objectively evaluating the current state or condition of **athletes** that will provide useful data for planning training and nutritional strategies to enhance athletic performance." [TAKAHASHI, H.]. Link to [the video](#) of the symposium.

Fiber-type composition of muscle determined non-invasively with **magnetic resonance spectroscopy** shows big differences between sprint and endurance **cyclists**, but would this technique really "open opportunities for application in cycling talent orientation"? [VAN VOSSEL, K.]. A series of tests to determine the athlete's power-duration profile might be more useful.

A real-time **muscle contraction feedback** system that displays lower limb muscle contraction during pedaling improved the performance of an **amateur cyclist** over 4 wk in this case study. [ABE, N.]

Visual cues from underwater LEDs appear to be a bit better for **pacing** than beeps from a device under the **swimmer's** cap. [MCGIBBON, K.E.]

An **under-mattress device** for recording heart-rate variability during **sleep** of 20 **participants** looks to me like it has problems with missing data and bias. [VESTERINEN, V.]

A **smartphone app** was useful for some lower-limb **kinematics** in 20 **female recreational runners**. [MOUSAVI, S.H.]

The **Fitlight** Trainer system and **MySprint iPhone app** were both accurate for assessing **sprint times** in 11 **youth basketball** players. [CONTE, D.]

Interesting novel hardware: a **mechanical rower** to validate **rowing** ergometers [MENTZ, L.], a **machine to pass balls** in **American football** [HOLLAUS, B.], and **cycling-shorts padding** for **female cyclists** [LARSEN, A.S.].

Various **technologies** and techniques may be interchangeable for assessing **vertical-jump performance** of 51 **male volunteers**. [GUMUS, H.; BROOKS, E.R.]. I would need to analyze the data to see how the technical errors compare with the jump-to-jump variability.

The Xsens **inertial motion capture** system was presented as "a more precise kinematic measuring system", but it sometimes had substantially lower reliability correlations than those of a digital inclinometer or measuring tape in three tests for range of motion with 22 **sports students**. [MALTRY, L.]. Technical errors of measurement would resolve this issue.

A study of 96 **young male soccer** players

"suggests that the 20 meters **passing-specific task** could be employed as an exercise training regime to increase the right-or-left foot efficacy of players." [FERNANDES, T.]

A new method to measure **fat oxidation rate**, involving ¹³C-labeled glycogen and indirect calorimetry, shows that the rate does not peak at moderate exercise intensities but plateaus through **endurance** competition intensities to 100 %VO₂max. The new method has a lower CV (14% for oxidation rate, 5% for %VO₂max) than traditional indirect calorimetry (78%, and 10%). [RIIS, S; KOPETSCHNY, H]. Nice for better understanding of the role of fat metabolism in endurance and ultra-endurance, but will it lead to new strategies for performance enhancement?

"Cross-country double-poling skiing performance could be predicted with high accuracy (SEE=2.0%)" by **lactate threshold** speed in a correlational study of 18 (12 M, 6 F) **trained skiers** [JOHANSEN, J.]. But the standard error of the estimate is huge, given the smallest important of ~0.2% in cross-country skiing. Lactate threshold is not worth measuring in these athletes!

What's the best way to **prescribe intensity of intervals** for individuals? Judging by a mixed-modelling approach to predict the relationship between time to exhaustion and intensity of 18 **recreationally-trained cyclists**, a percentage of peak power output in an incremental test was slightly better than other methods to normalise intensity (delta concept, time-trial performance, and critical power). CVs of times to exhaustion varied from 52% to 80% [BOSSI, A.H.]. By my calculation, a CV of ~50-60% in a time to exhaustion is equivalent to ~3-4% in time-trial power, which still represents a considerable between-athlete difference in intensity. Maybe prescription would be better based on some fraction of maximal sprint power, or just self-paced.

By analyzing intraclass correlation coefficients and significance of differences in means, the authors argued that a **3-min all-out test** was reliable and valid for **junior elite flat-water kayakers**. [PILOTTO, A.M.]. I'd like to see error of measurement compared with that of time trials, and consideration of the smallest important.

A case study involving 13 weekly **submaximal cycling tests** and assessments of a **female** preparing for the **Ironman** triathlon allowed the

authors to conclude that "individualized protocols can be a practical and pragmatic alternative to standardized tests and provide valuable information for training adjustments." [SCHNEIDER, C.]

The REDI (robust exponential decreasing index) is a new measure of **accumulated workload** that allows for missing data. The abstract gives no useful methodological detail. [MOUSSA, I.]. It would be good to see how it compares with mixed-model imputation of missing data.

Training

Wow! There was no control group, but there was a spectacular 3.0% improvement in "15-m swimming with pull motion without kick" of 12 **collegiate division-1 swimmers** following an unspecified period of "eight types of **core training** mainly focusing on draw-in and stabilization". The improvement was attributed to shoulder-muscle strength and underwater posture. [JIGAMI, H.]. What would be the effect on 50-m time?

I missed the symposium on **individualization and optimization of training prescription**, and the abstracts are not particularly informative [LAMBERTS, R.P.; HOPKER, J.; RONNESTAD, B.R.], so I have summarized [the video](#). Rob Lamberts presented data on **cyclists** showing (somewhat off the topic) different time courses for recovery of submaximal heart rate, perceived exertion, heart-rate recovery and exercise efficiency following days of intense training or competition. He combined these and other measures into a single measure of **fatigue**, but he didn't state how he combined them nor how it could be useful. James Hopker provided evidence that intensity prescribed as a given percent of VO₂max represents a different intensity for different individuals (as shown by time to exhaustion at that intensity; see Arthur BOSSI's abstract [above](#)) and could therefore account for individual differences in the training response. Prescription based on perceived exertion showed potentially less individual differences, but a training study of short vs long intervals with trained **cyclists** did not resolve the issue of individual responses. Bent Rønnestad reviewed his published studies on **endurance athletes** showing that shorter intervals are better for improving endurance performance, possibly because shorter intervals result in more time above 90% of VO₂max. Watch for publication of a meta-analysis of six studies showing that it's better to

block-periodize the interval sessions, for example into an intense week (5 sessions) followed by three easier weeks (single sessions) rather than 4 wk of 2 sessions per week.

A **linear periodization** group of 10 **recreational runners** went through a 6-wk high-volume training program while a **reverse periodization** group of 10 performed higher intensity, lower volume training. Training volume and intensity were then reversed in a second 6-wk block. A control group of 10 trained without periodization. Time in a 5000-m trial improved by 77, 113 and 4 s in the linear, reverse and control groups (~8%, 10% and 0%), "highlighting the importance of planned training structure." [BRADBURY, D.G.]

By changing training in an under-17 team of 16-17 **female elite soccer** players in consecutive seasons, the researchers concluded that "**periodized power training** (low-to-high intensities, maximal movement velocities) significantly better improved power and linear speed measures, but also maximum muscle strength compared with local muscular endurance (low to medium intensities, slow movement velocities) in female young elite soccer athletes. It is recommended to regularly include lower-limb muscle power exercises." [LESINSKI, M.]

Eleven male and female **middle-distance runners** who got worse ("**functionally overreached**") in an incremental test after 3 wk of overload rebounded somewhat following a 1-wk taper, but 11 runners who got better after the overload got much better after the taper. (Sorry, I can't translate the change in test times into percents.) [BELLINGER, P.]. Which all goes to show that, when aiming for super-compensation, it's better not to overdo an overload to the point of worse performance.

One **sprint session** a week for 3 wk in the post-competition low-intensity phase of training rescued ~1% of endurance power output in this controlled trial of 8+8 **trained cyclists**, which is borderline substantial for these athletes (the authors claimed otherwise). Whether it was clear is not clear! [BYRKJEDAL, P.T.]

Unsurprisingly, adding **sprints** to **high-volume low-intensity training** improved sprint and endurance power (measured after a 10-d taper) in a controlled trial of 9+9 **elite cyclists** attending a 14-d training camp. [ALMQUIST, N.W.]

A **Nordic hamstring exercise** administered 1-3 times per week for 8 wk produced useful improvements in various performance tests in a

controlled trial of 10+9 **female elite handball** players. [CHAABENE, H.]

"Reducing competitive long distance runners' endurance training by 1 h and adding 2 h of **strength training** per week resulted in greater improvements [in endurance-performance markers] when compared to adding an additional hour of endurance training" in a controlled trial of 9+10 **runners**. [FLYNN, M.F.]

It's the usual summary of effects as p values, but in this e-poster abstract it looks like 16 junior soccer players who performed 6 wk of **iso-inertial training** with a flywheel device experienced more improvements in a wide range of performance tests and **soccer** shooting precision than 16 control players doing conventional soccer training. The device is not named or described. [BUONSENSO, A.]. Almost a Wow!

Adding **blood-flow restriction** to **heavy-load resistance training** in alternate weeks over 6 wk total resulted in a 12% increase in maximal isometric knee extensor strength compared with 7% in control (training with blood-flow restriction) in 9+9 **active males and females**. So why did the authors conclude that "alternating weekly blocks of HRT and BFR-RT were not superior to HRT in producing gains in muscle strength"? You can imagine. [HANSEN, S.K.]. They included several potentially misleading difference-in-significance outcomes.

The authors used a Bayesian approach to assess the effect of live-high train-high **altitude camps** vs sea-level training on competitive swimming performance over 50, 100 and 200 m in 41 **elite swimmers**, specifying "a region of practical equivalence" (trivial effects) of $\pm 0.2\%$. Yet what they reported as "similar performance" in one year was obviously unclear but tending towards benefit for altitude, especially for 50 m (1.2%). They correctly reported clear impairment in 50-m swims the following year (-1.3%), but "no difference" was again actually unclear for the 100- and 200-m swims. Overall it's evidence to avoid altitude camps for sprint swimming, at least for some athletes (but which?). [WINTHER, A.K.]

Seven well-trained **male distance runners** who did sprint and endurance **training** in **hypoxic** conditions for 5 d improved their time to exhaustion by 54% (~3-4% in a time trial—my estimate) compared with eight who trained in normoxia. Running economy may have been the mediator. [TANJI, F.]

A 10-d combined **heat** and **hypoxia** acclimation "conditioning cocktail", if anything, was less beneficial than training in normoxic thermoneutral conditions in this crossover with eight **trained males**. "Adoption of such a training protocol as an ergogenic aid in preparation for the Tokyo Olympics does not seem warranted." [SOTIRIDIS, A.]

Five weeks of **heat training** (five 1-h sessions per week at 35-40 °C) in 12 **trained cyclists** resulted (surprisingly) in a ~5% increase in hemoglobin mass compared with 10 matched control cyclists. [OBERHOLZER, L.]. This would have earned a Wow!, if the authors had reported the effect on endurance performance. It was probably ~2%, with a similar SD for individual responses.

Six sessions of cycling in the **heat** at 35 °C over 12 d produced a small enhancement of endurance performance compared with cycling at 18 °C in a controlled trial of 10+10 club-level **Australian-rules football** players. A short period of heat exposure before heat training in an-

other group of 10 appeared to be of little additional benefit. [PYNE, D.]

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